



FIG. 2

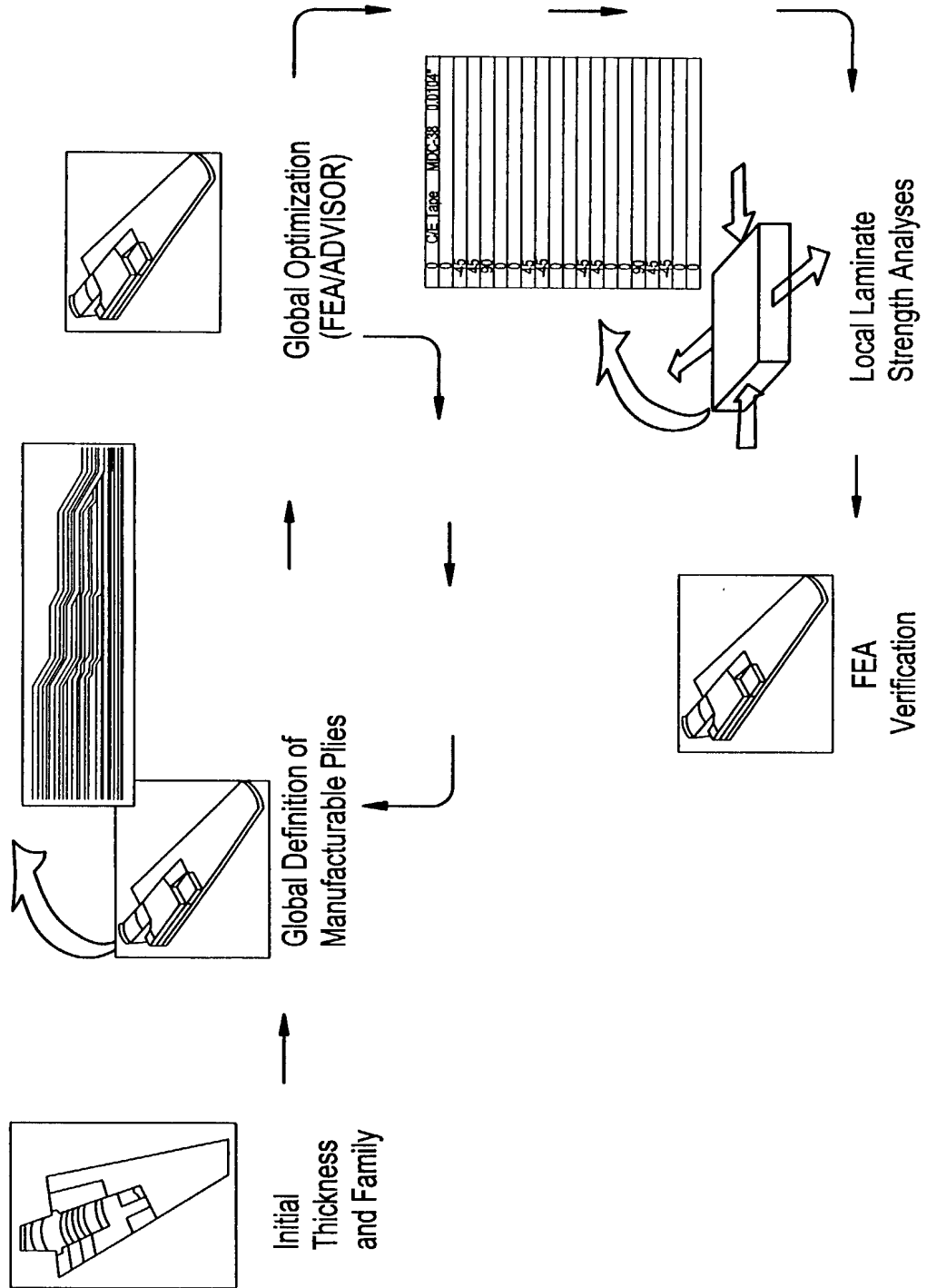
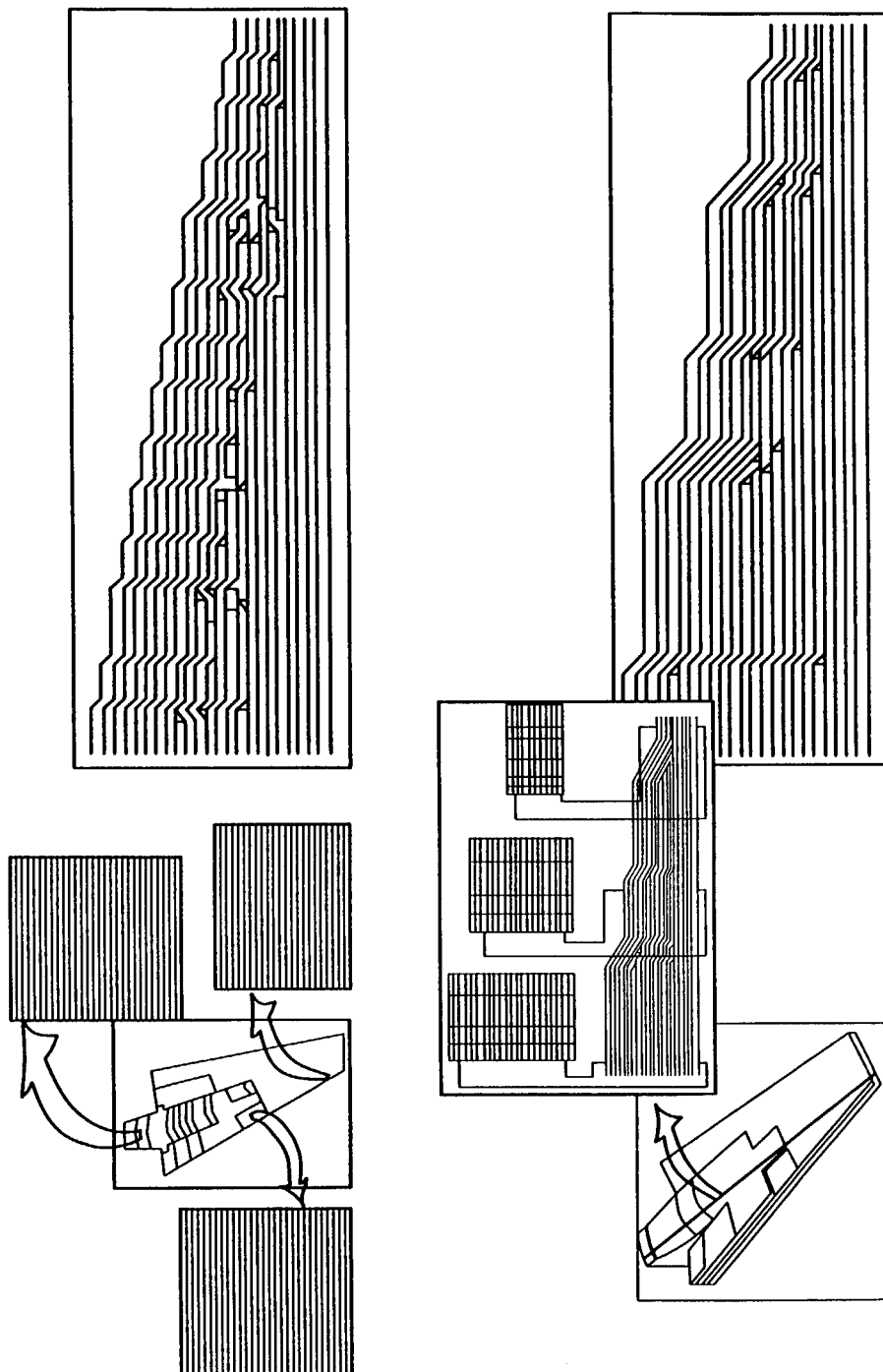


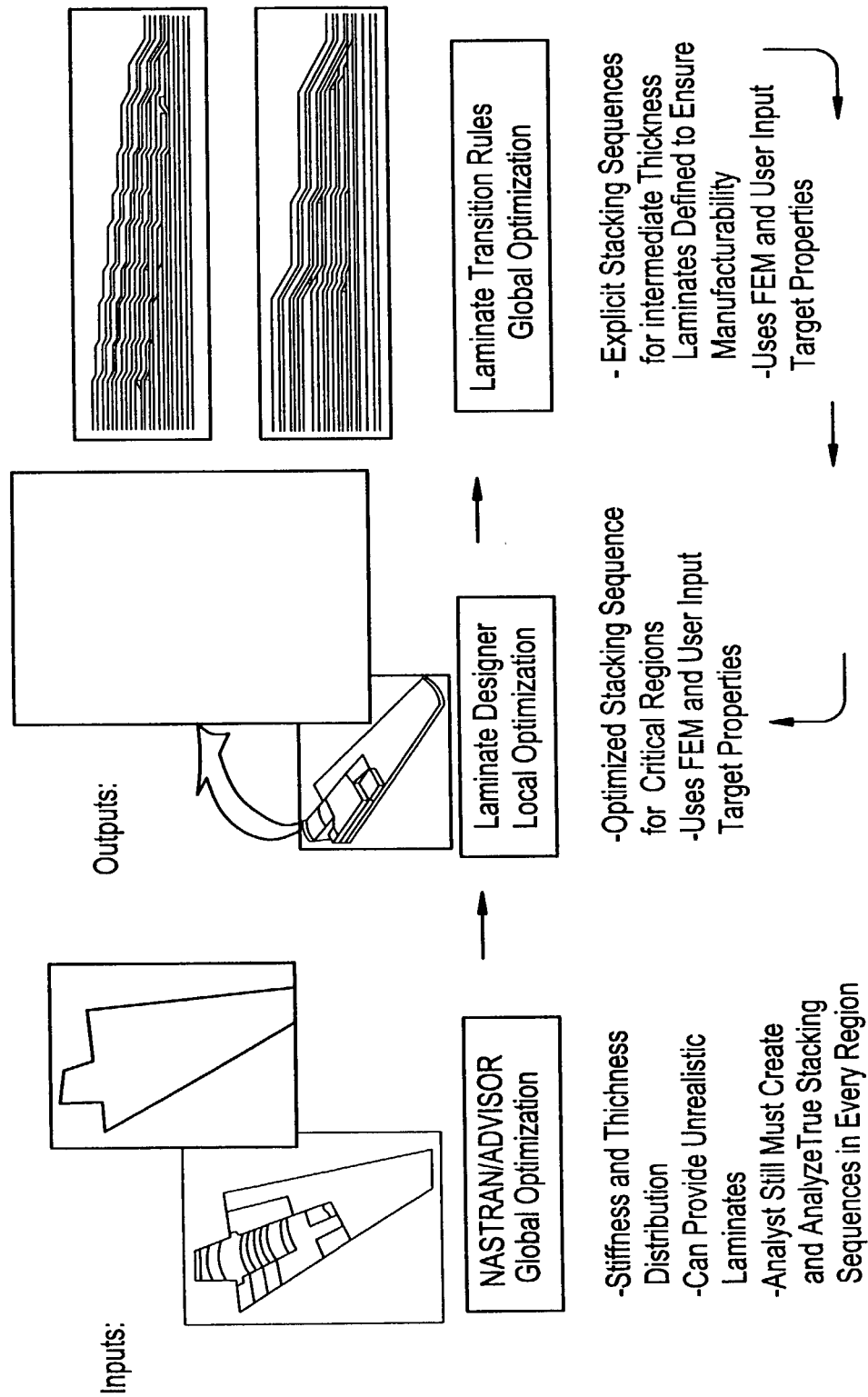
FIG.3

Thickness (# Plies)	Potential Families	Axial	Stiffness (msi) Transverse	Shear	Poisson's Ratio
17	--	13.23	5.30	2.79	0.42
18	--	13.23	5.30	2.79	0.42
19	--	13.23	5.30	2.79	0.42
20	50.0/40.0/10.0	13.23	5.30	2.79	0.42
21	--	13.23	5.30	2.79	0.42
22	--	13.23	5.30	2.79	0.42
23	--	13.23	5.30	2.79	0.42
17	41.2/47.1/11.8	11.59	5.88	3.14	0.42
17	47.1/47.1/5.9	12.56	4.68	3.14	0.52
18	44.4/44.4/11.1	12.19	5.67	3.01	0.42
19	42.1/42.1/15.8	11.78	6.60	2.89	0.35
19	47.4/42.1/10.5	12.74	5.48	2.89	0.42
19	52.6/42.1/5.3	13.61	4.39	2.89	0.52
20	50.0/40.0/10.0	13.23	5.30	2.79	0.42
21	42.9/38.1/19.0	11.90	7.10	2.69	0.30
21	47.6/38.1/14.3	12.80	6.12	2.69	0.35
22	45.5/36.4/18.2	12.38	6.86	2.61	0.30
22	54.5/36.4/9.1	14.07	4.97	2.61	0.42
23	47.8/34.8/17.4	12.82	6.64	2.53	0.30
23	52.2/34.8/13.0	13.65	5.74	2.53	0.35
23	56.5/34.8/8.7	14.44	4.83	2.53	0.41

FIG. 4



# FIG. 5





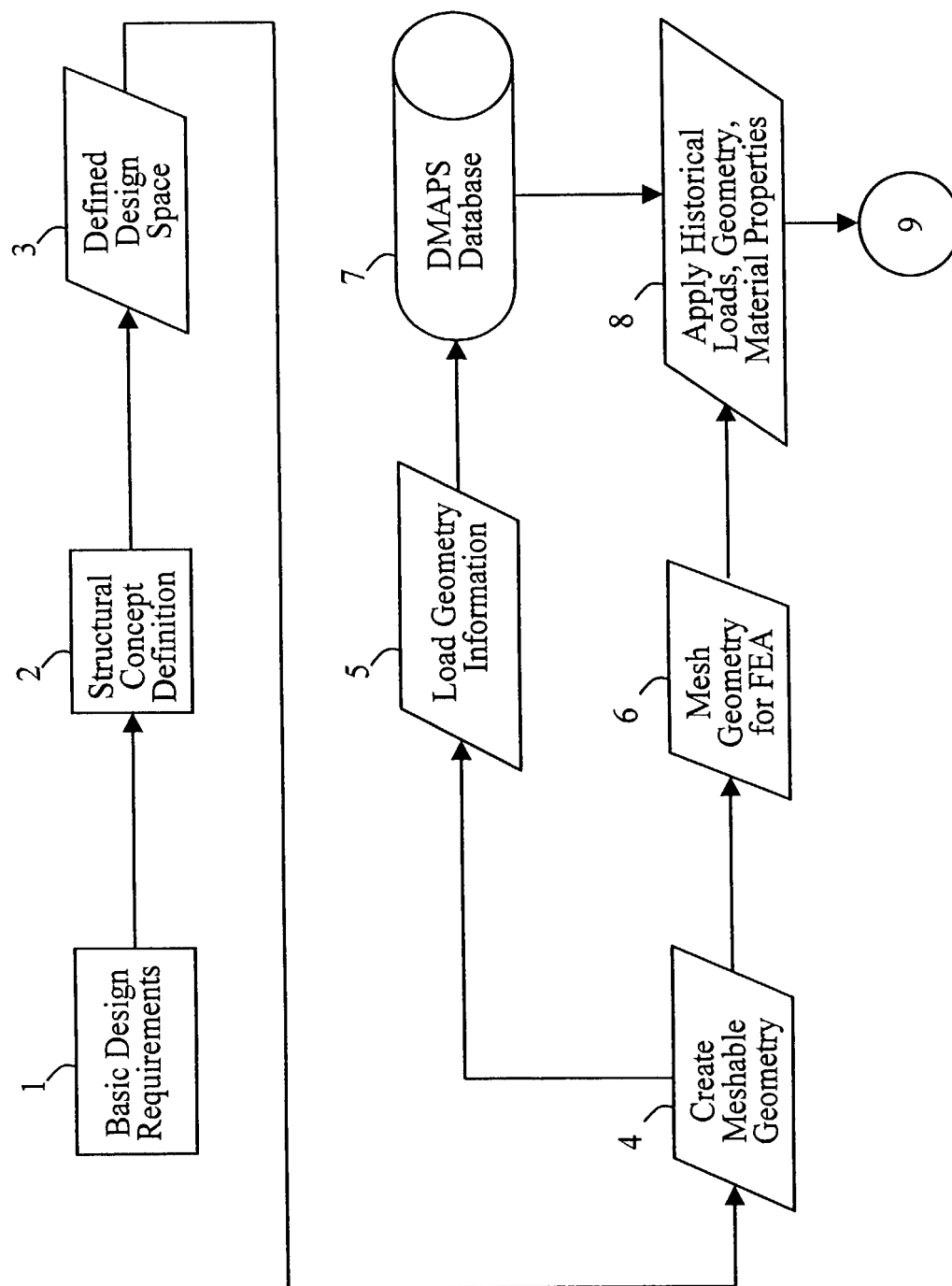
[illegible]

FIG. 7B

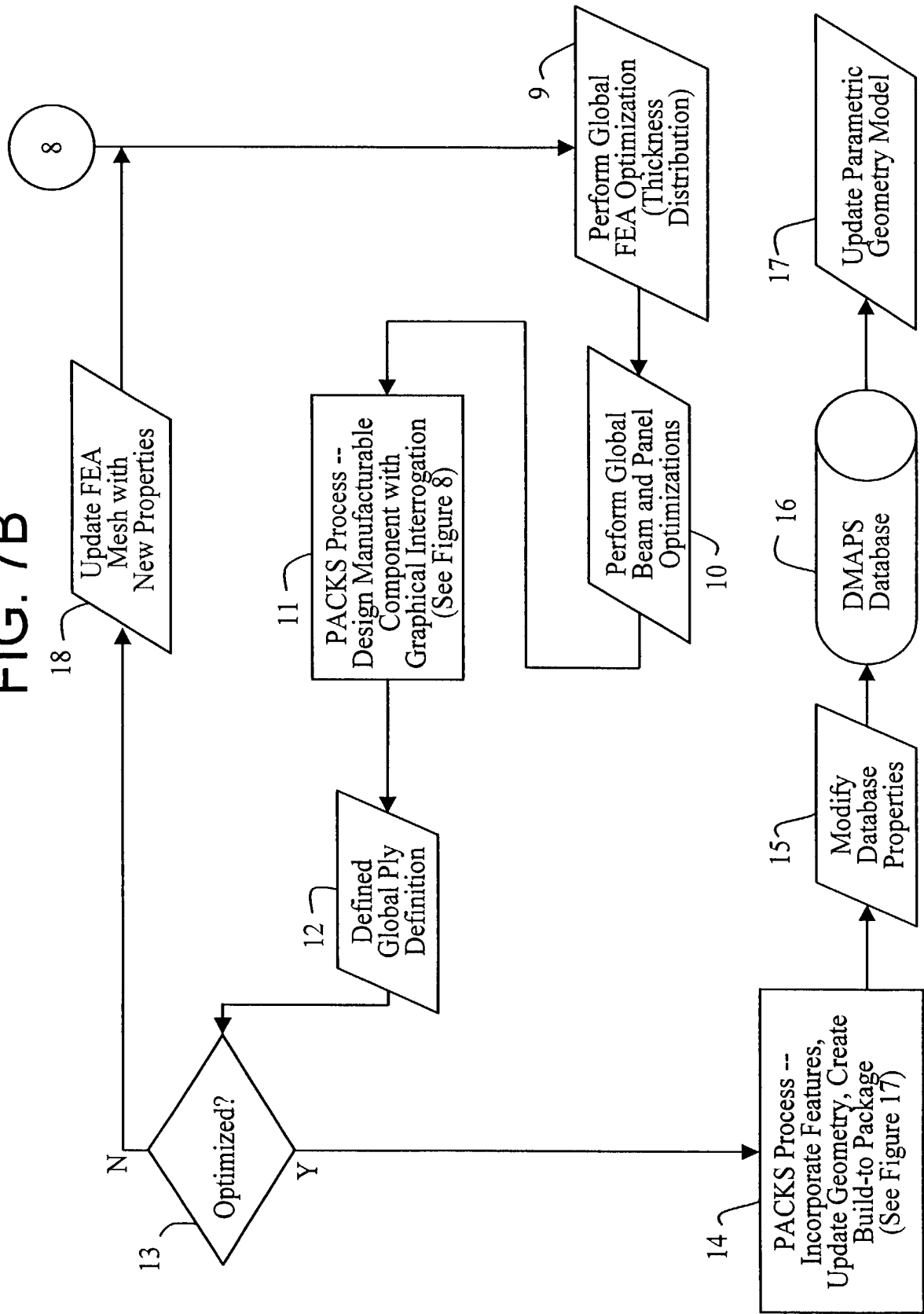




FIG. 8A

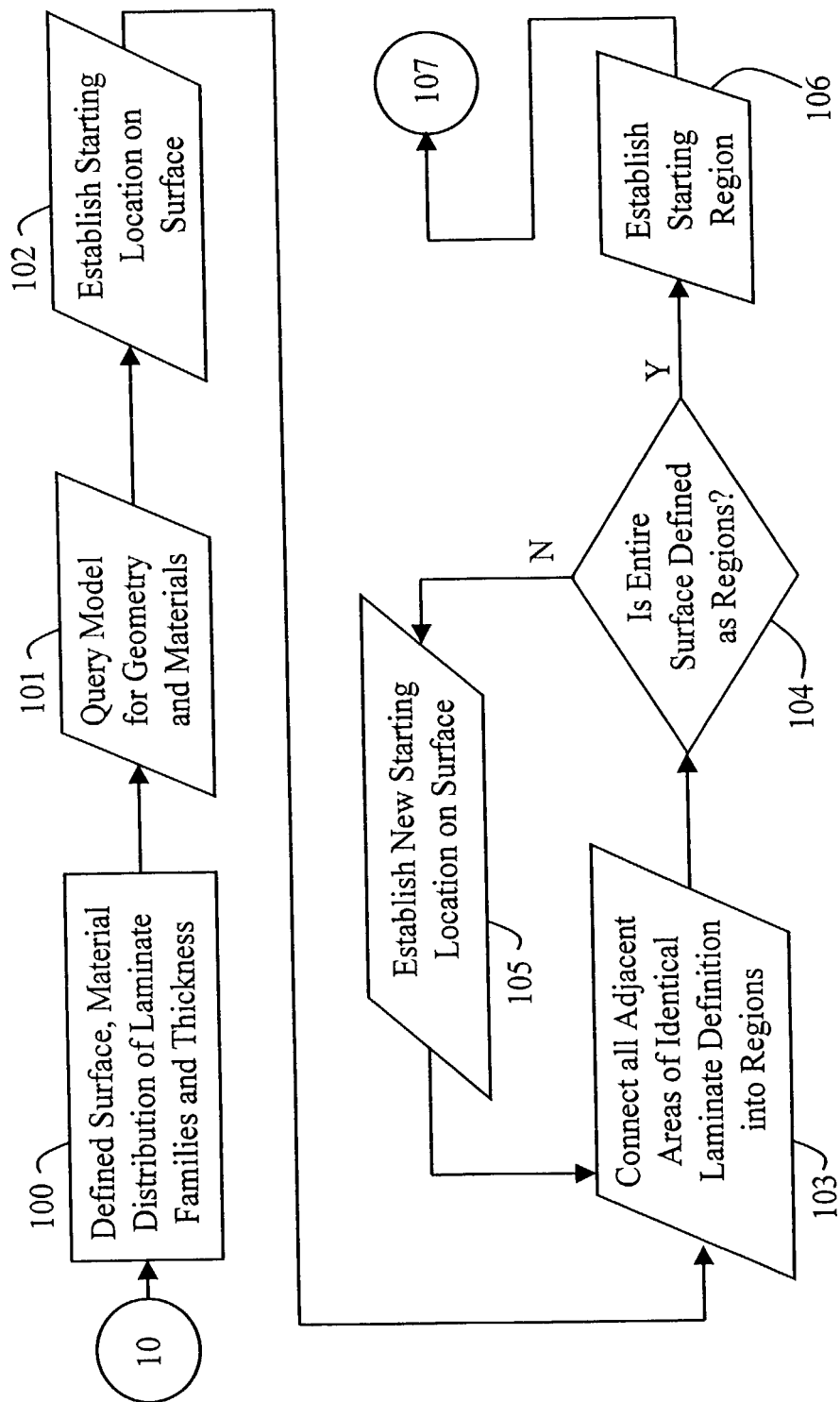


FIG. 8B

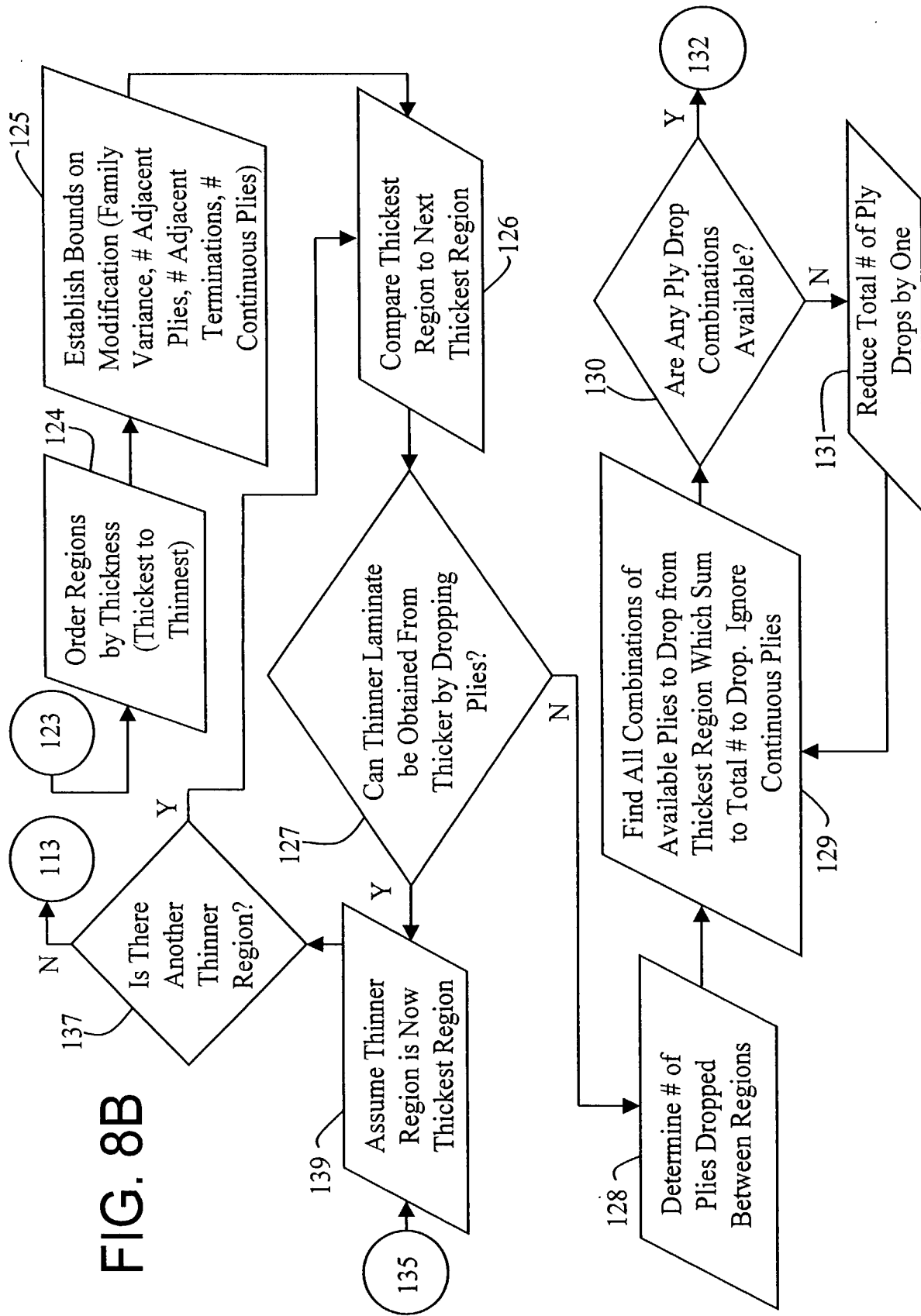


FIG. 8C

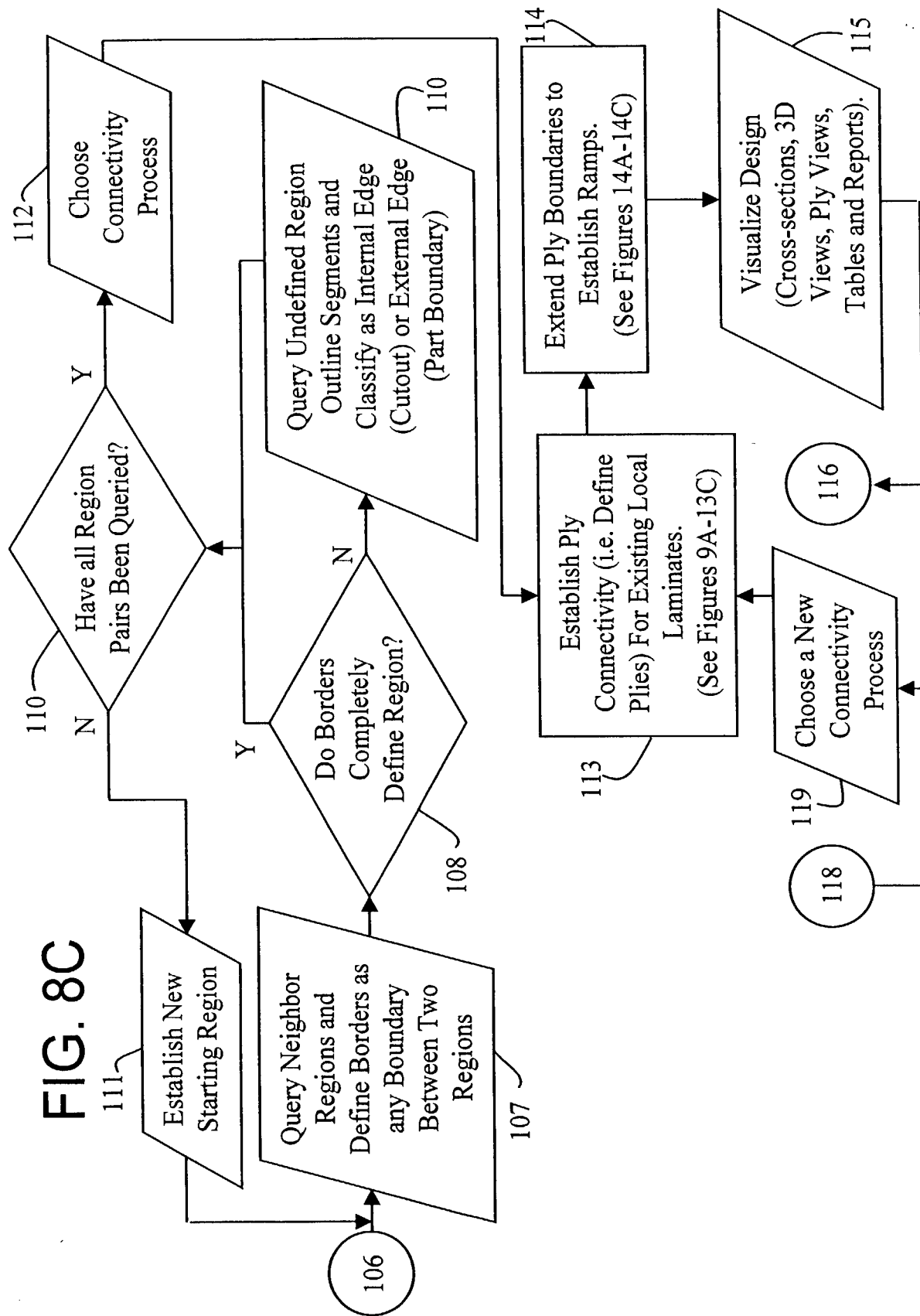


FIG. 8D

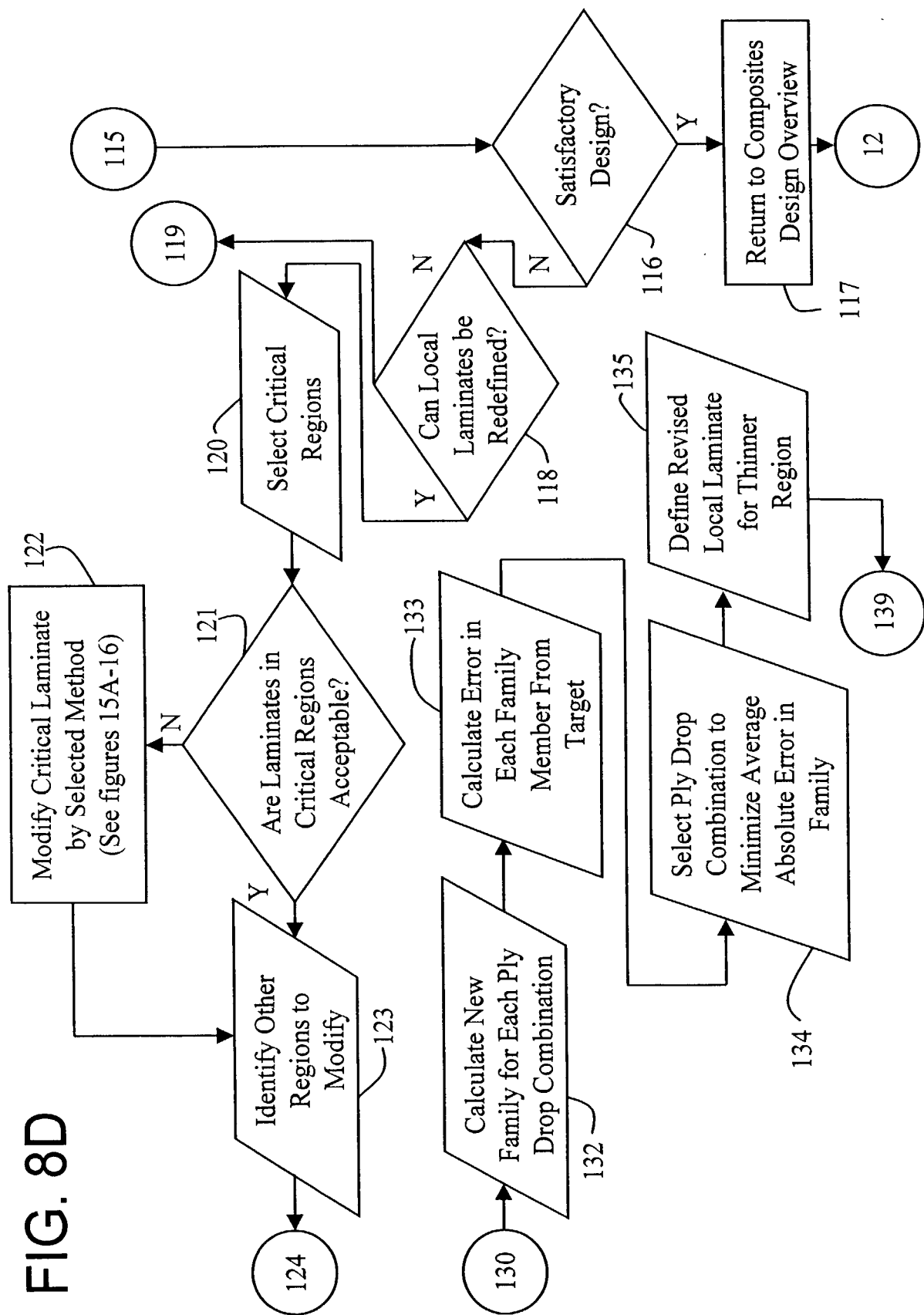


FIG. 9A

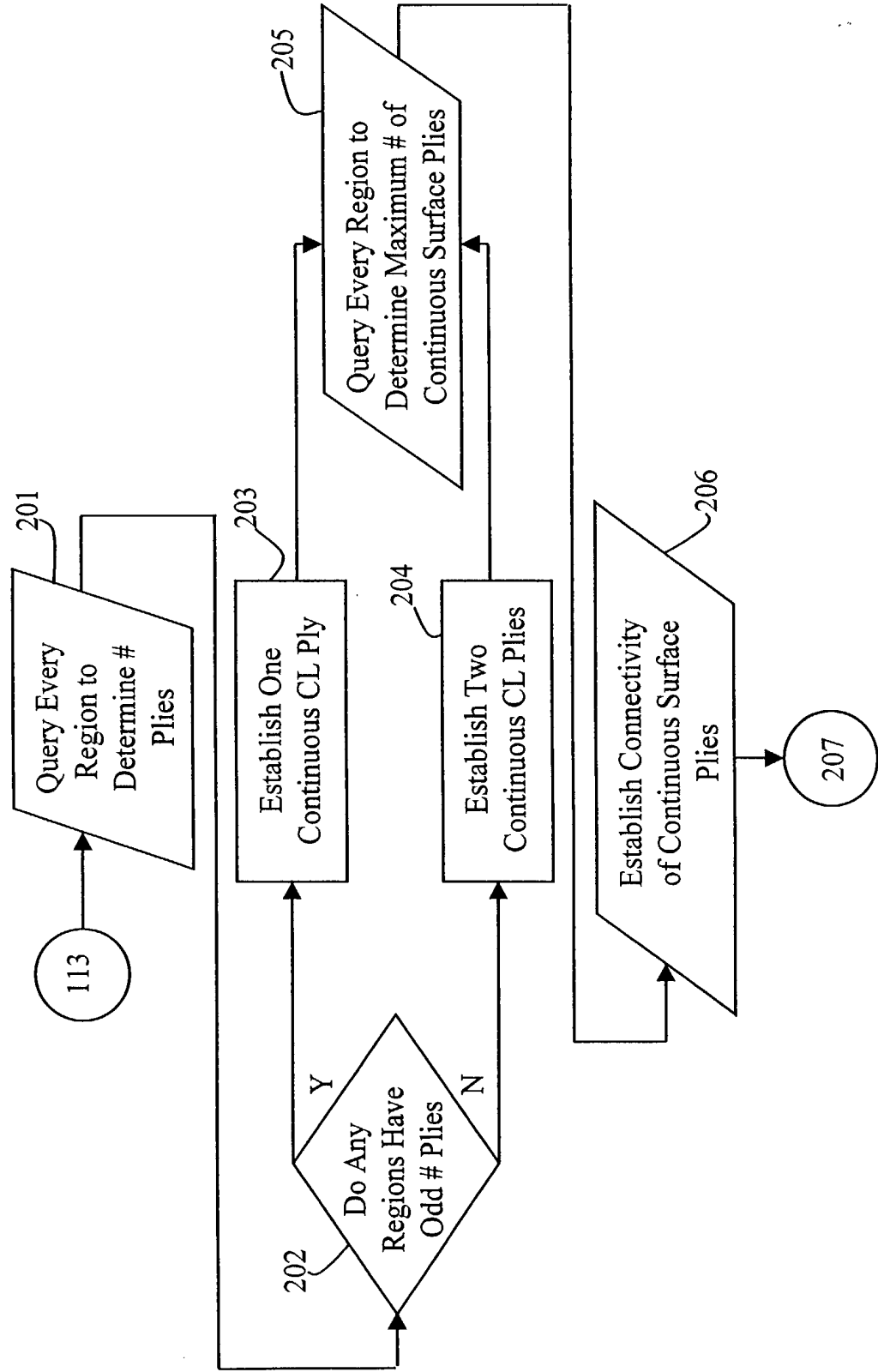


FIG. 9B

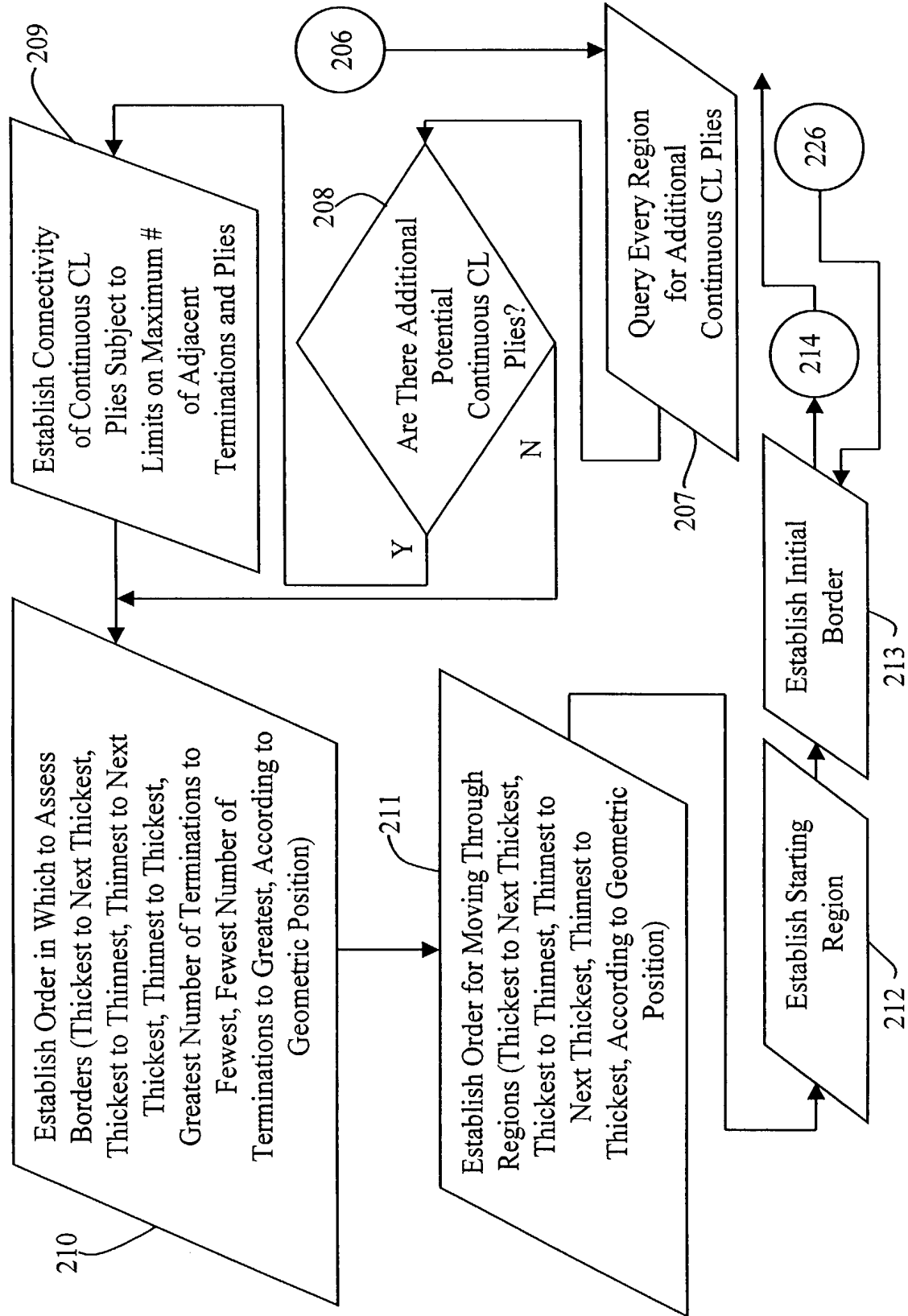


FIG. 9C

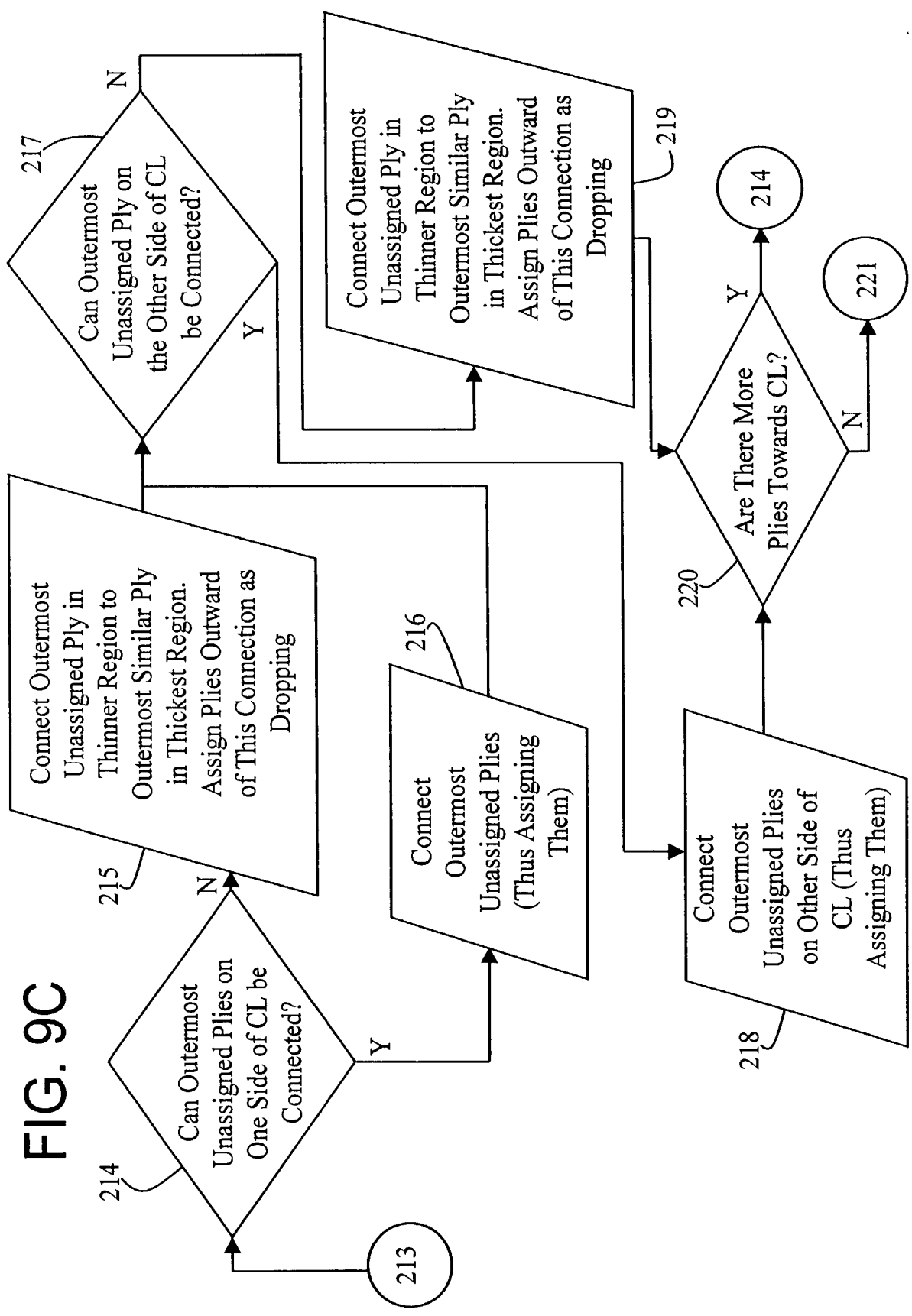


FIG. 9D

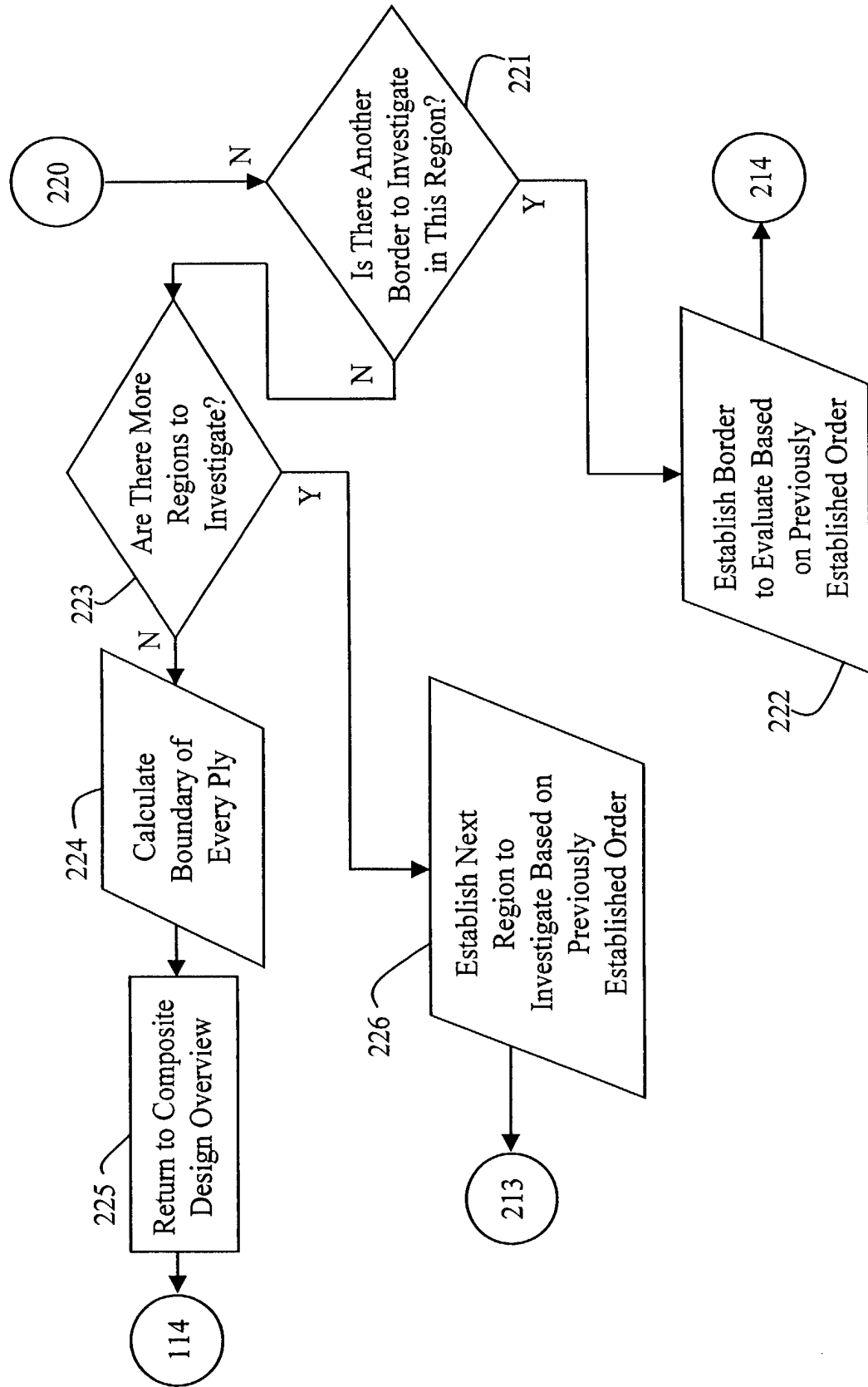
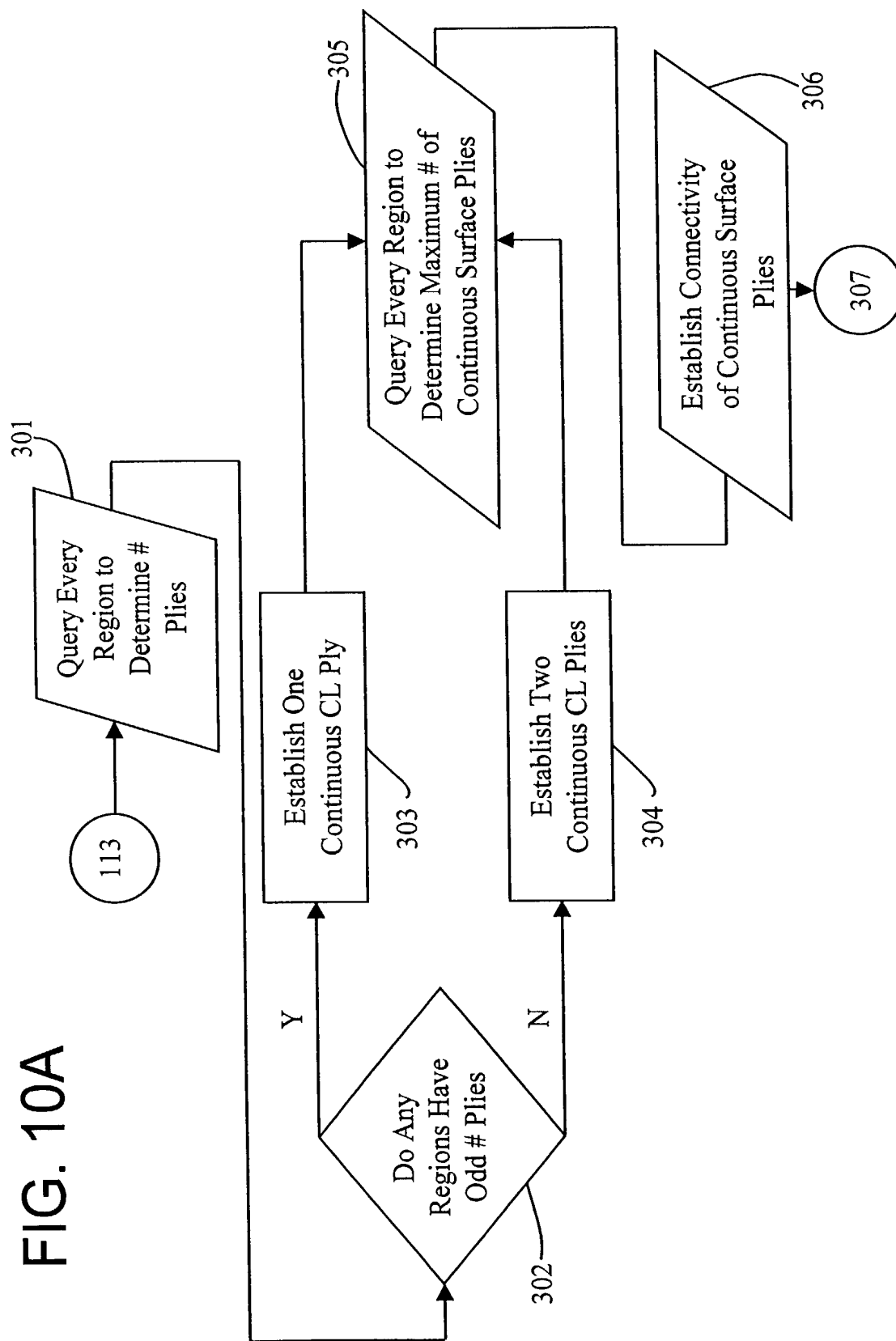




FIG. 10A



# FIG. 10B

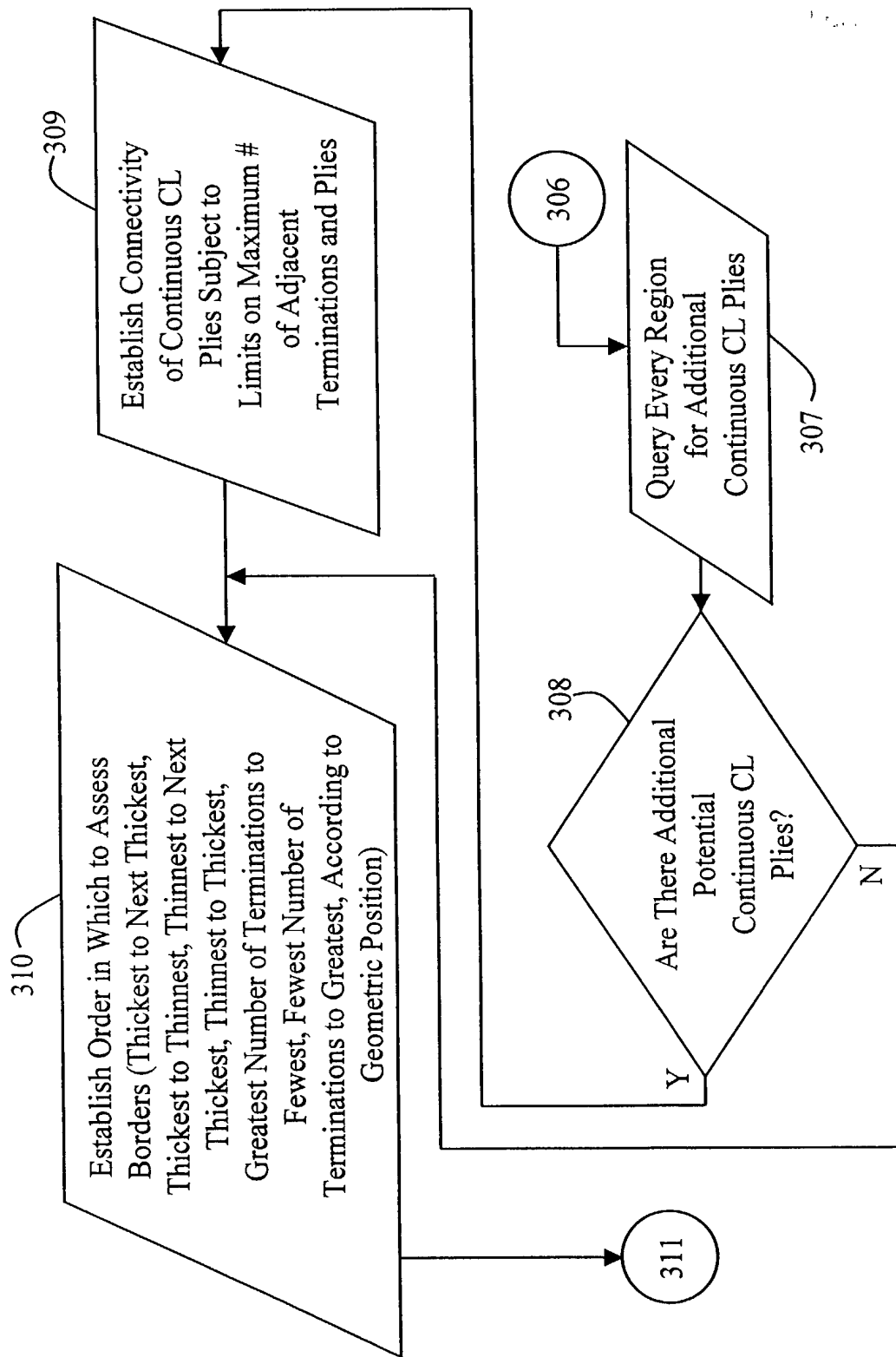


FIG. 10C

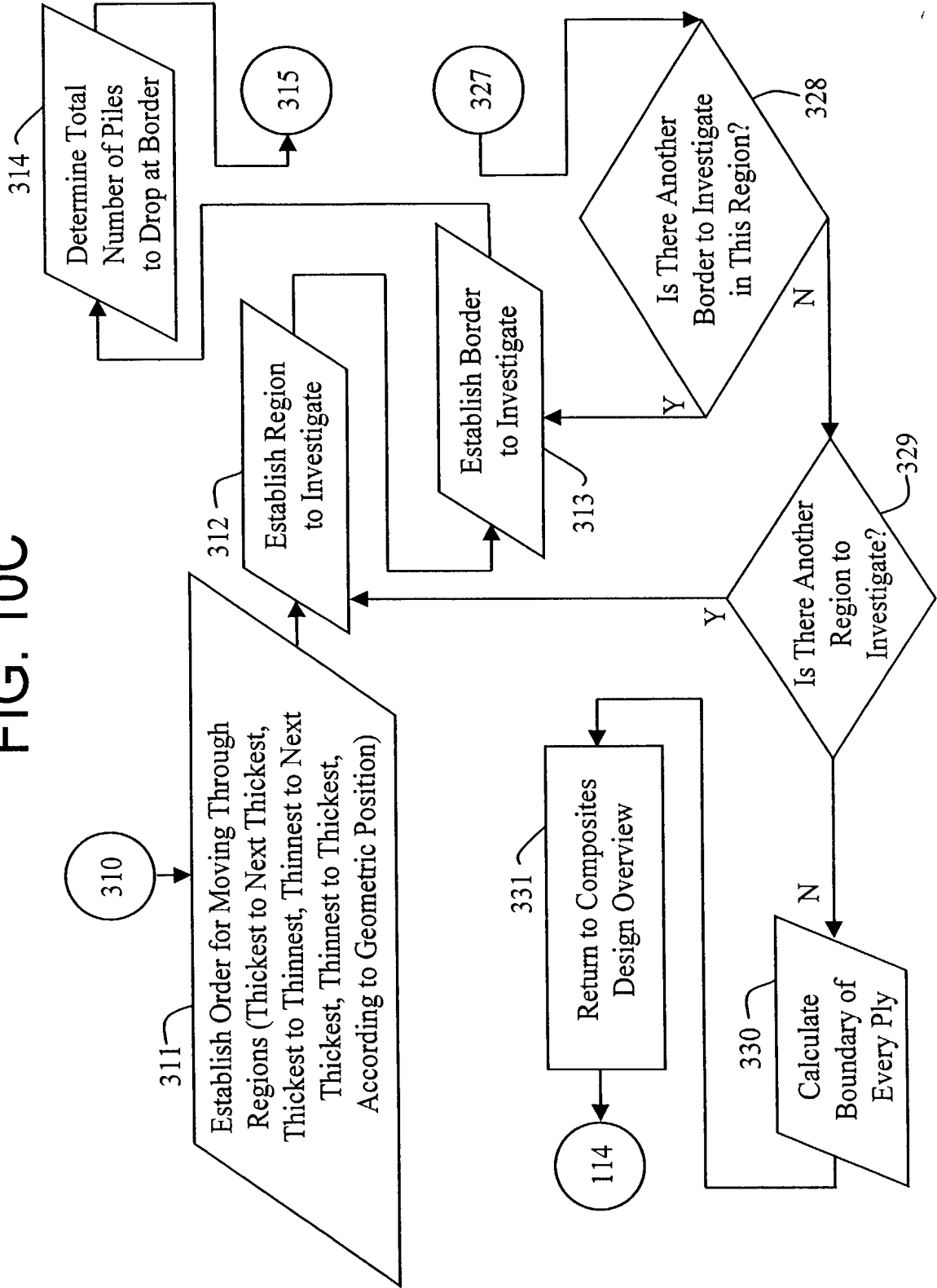


FIG. 10D

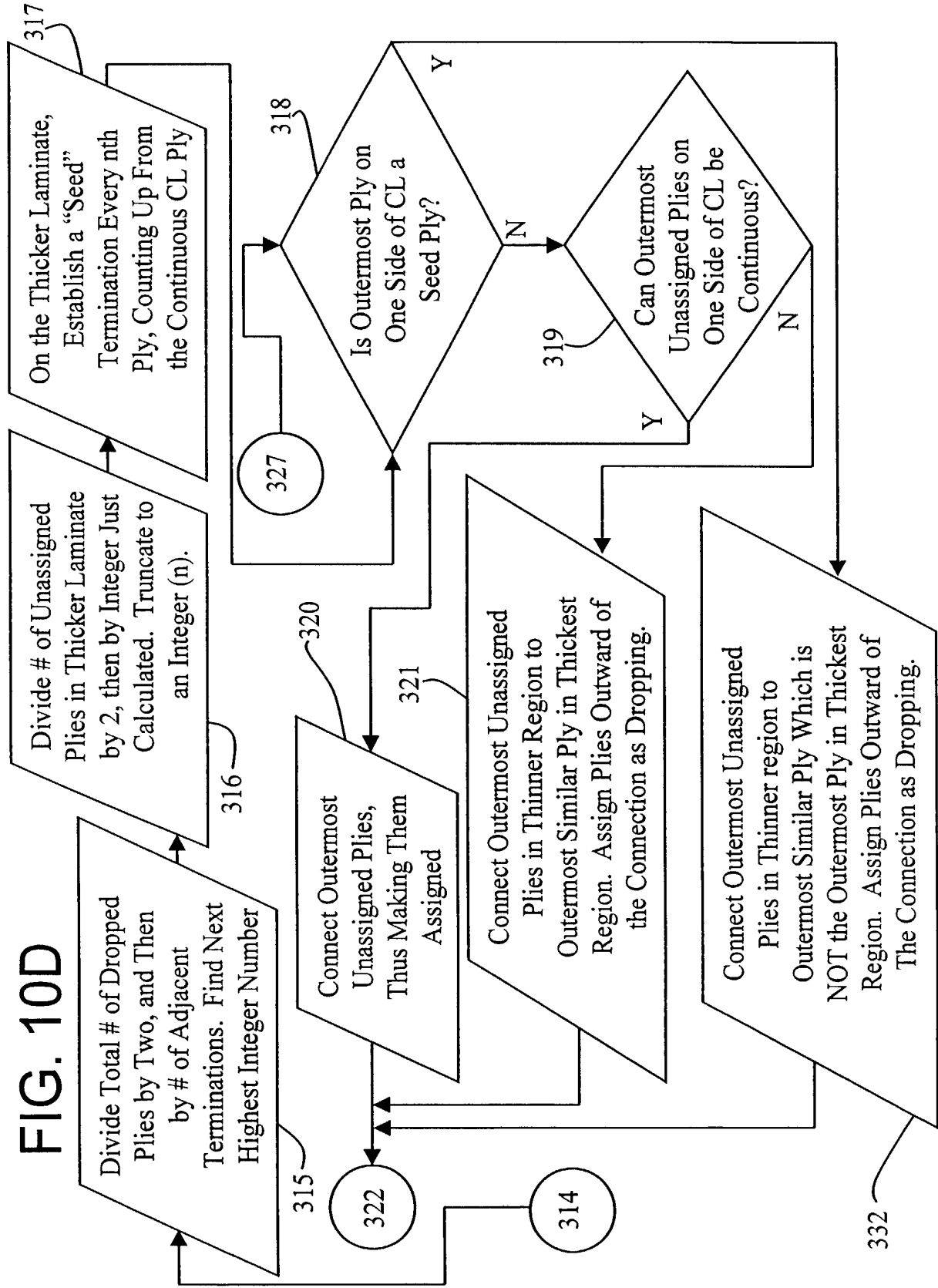


FIG. 10E

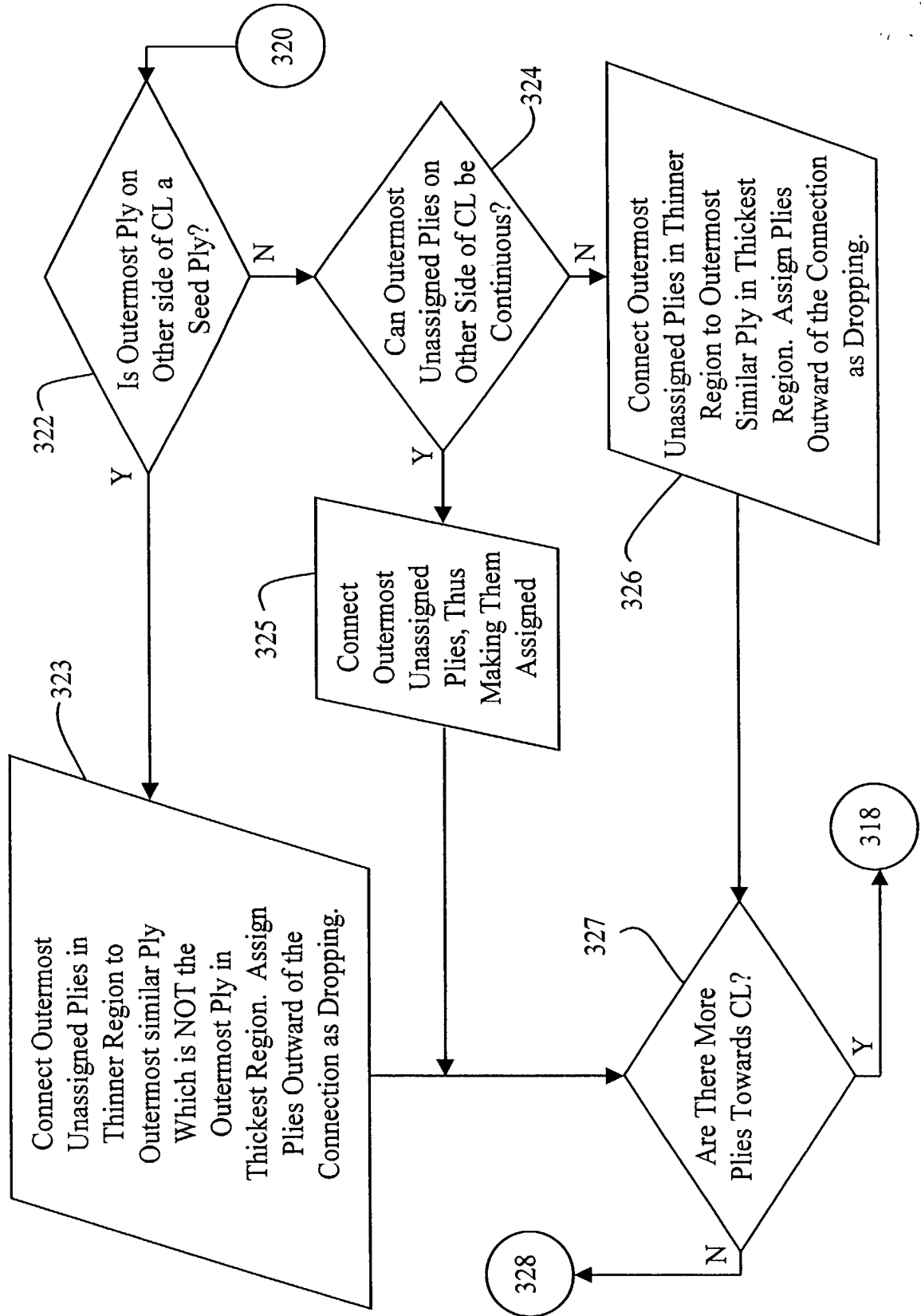
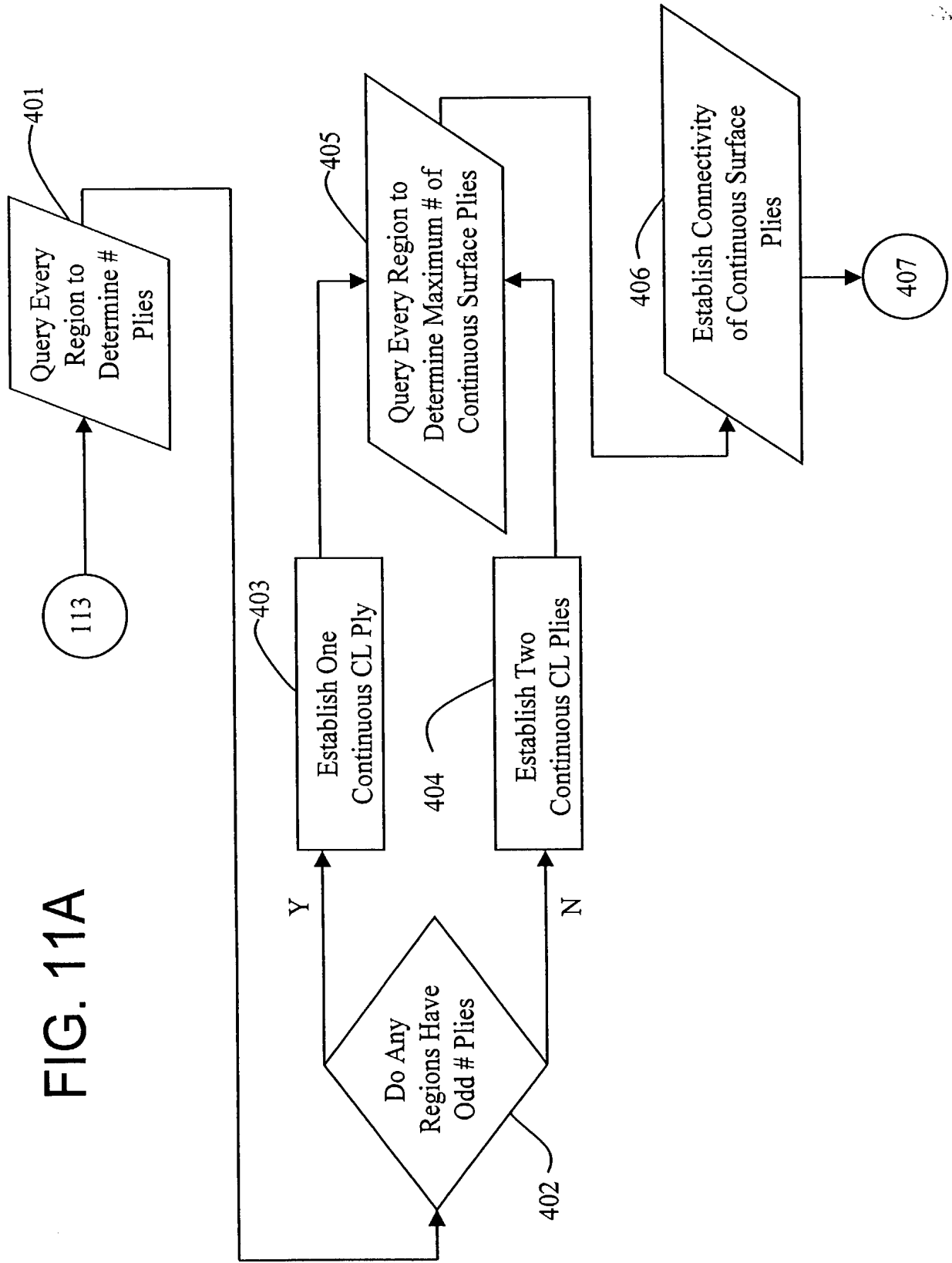
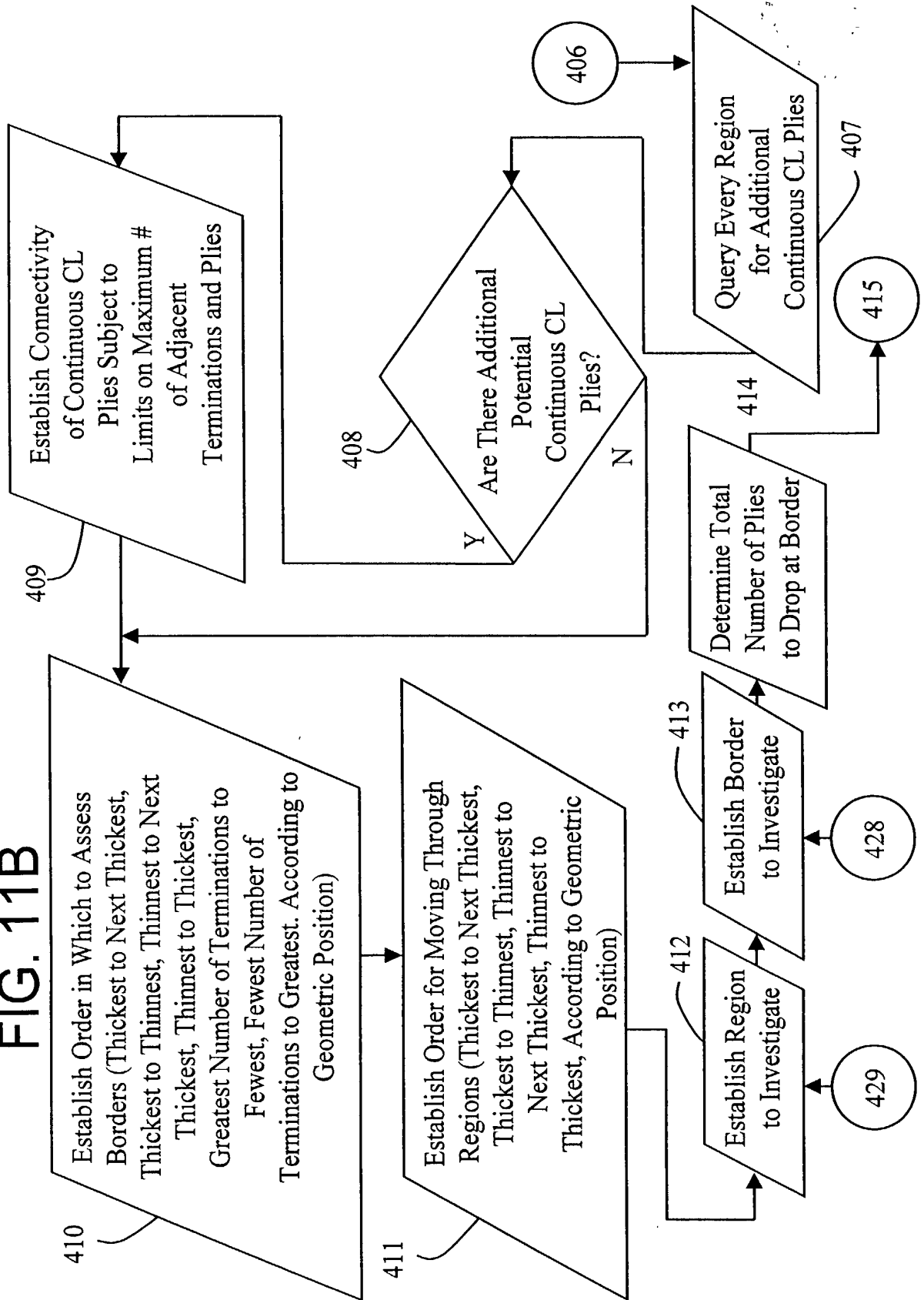


FIG. 11A



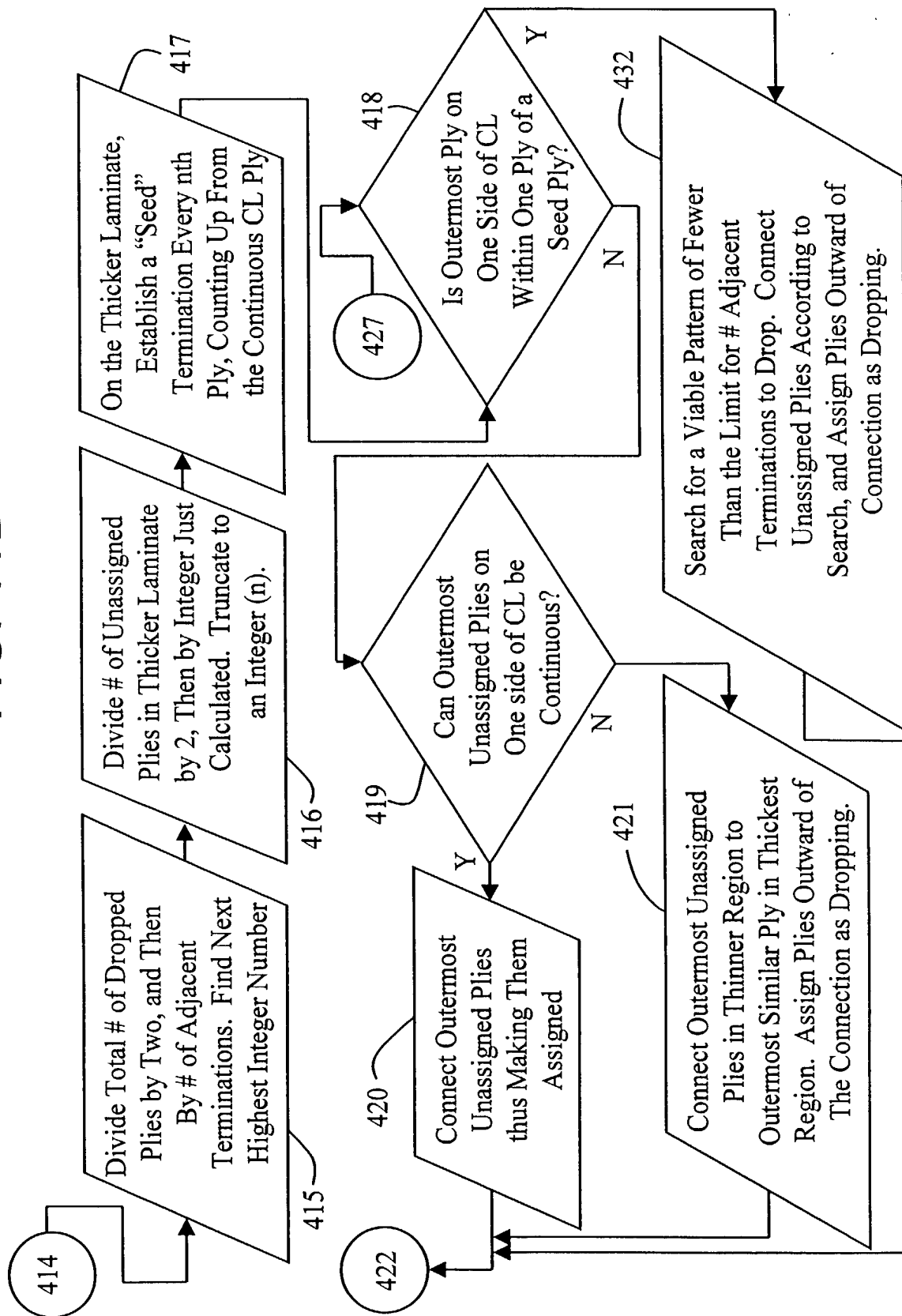
# FIG. 11B

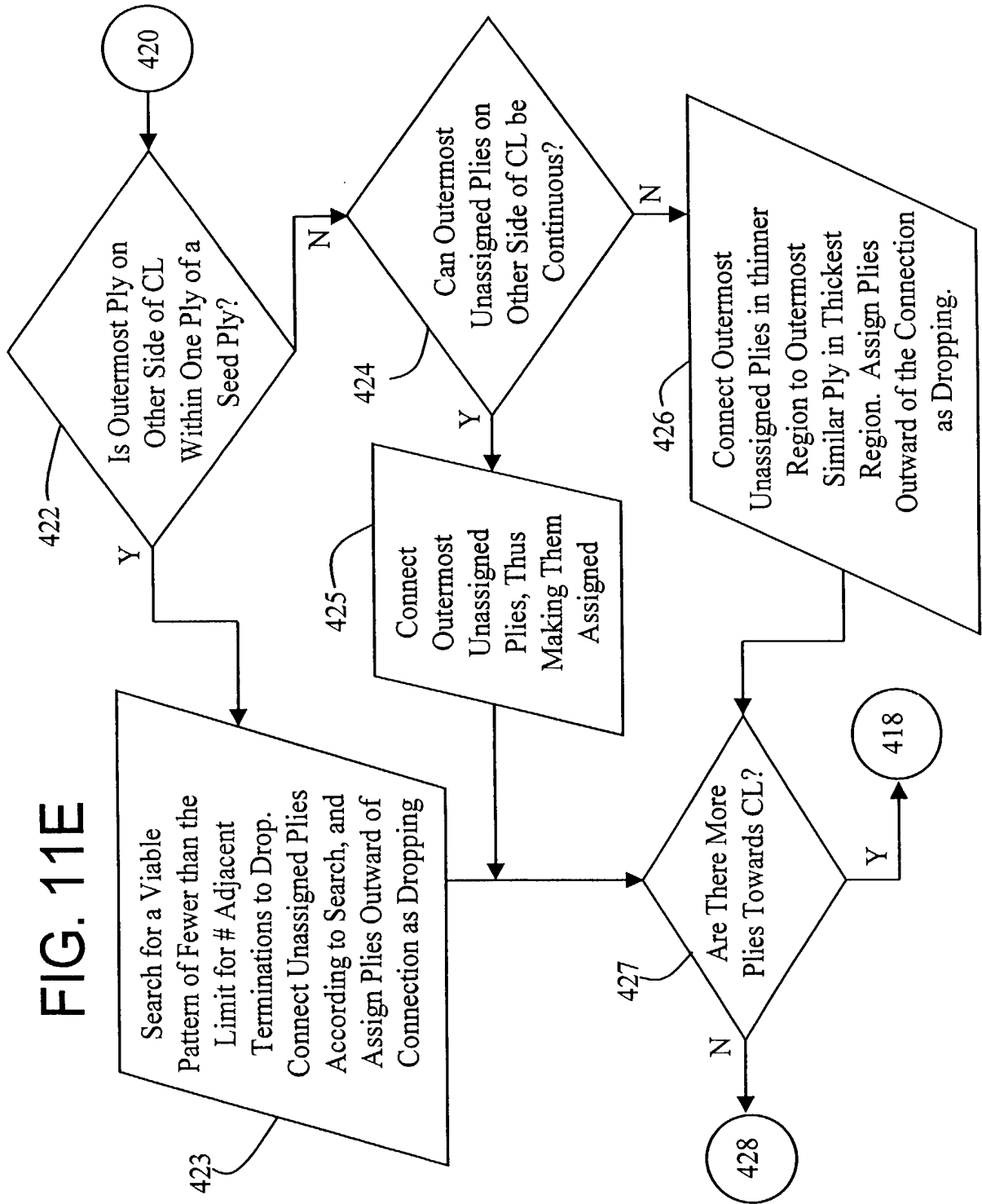






# FIG. 11D





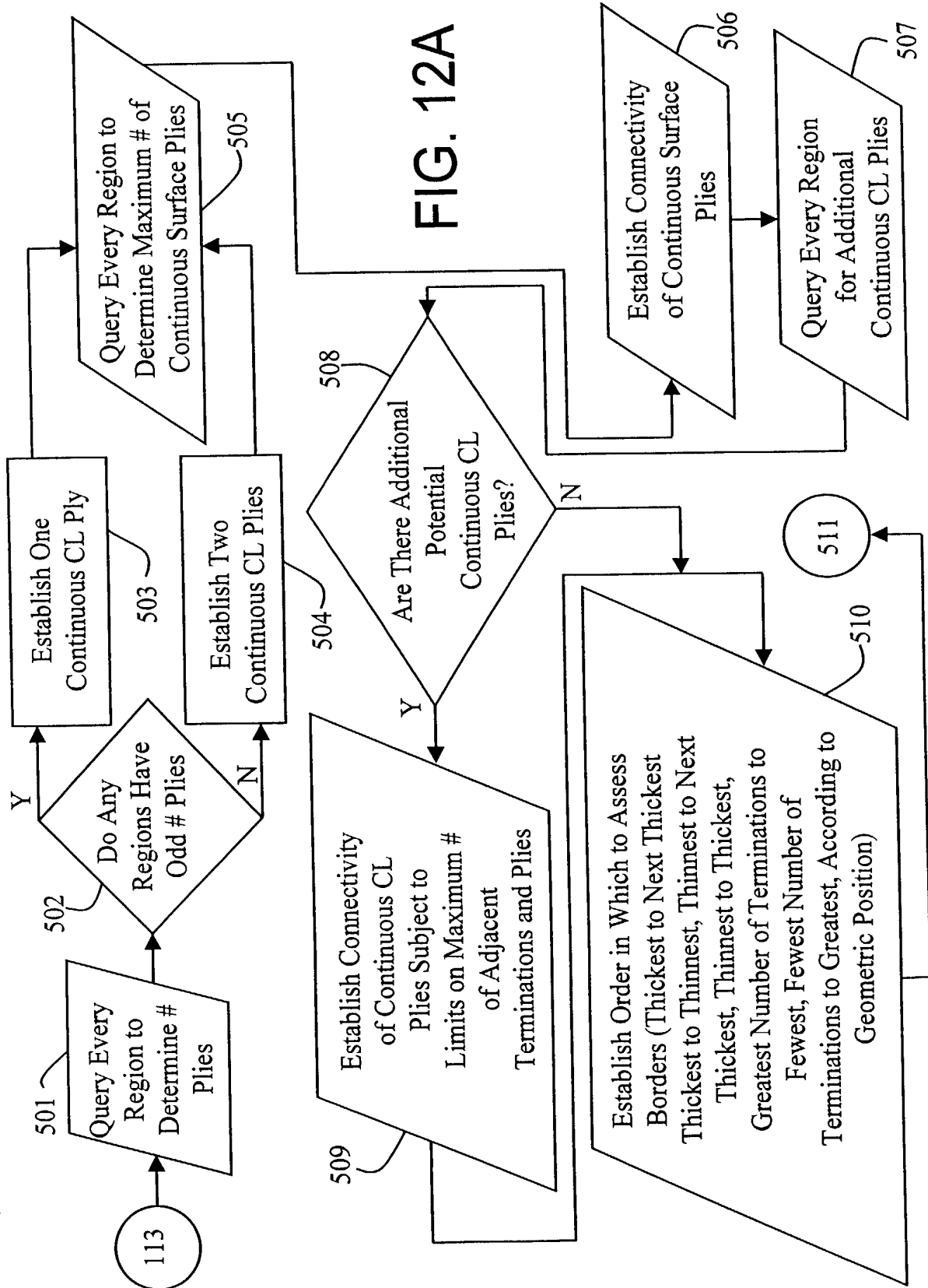


FIG. 12B

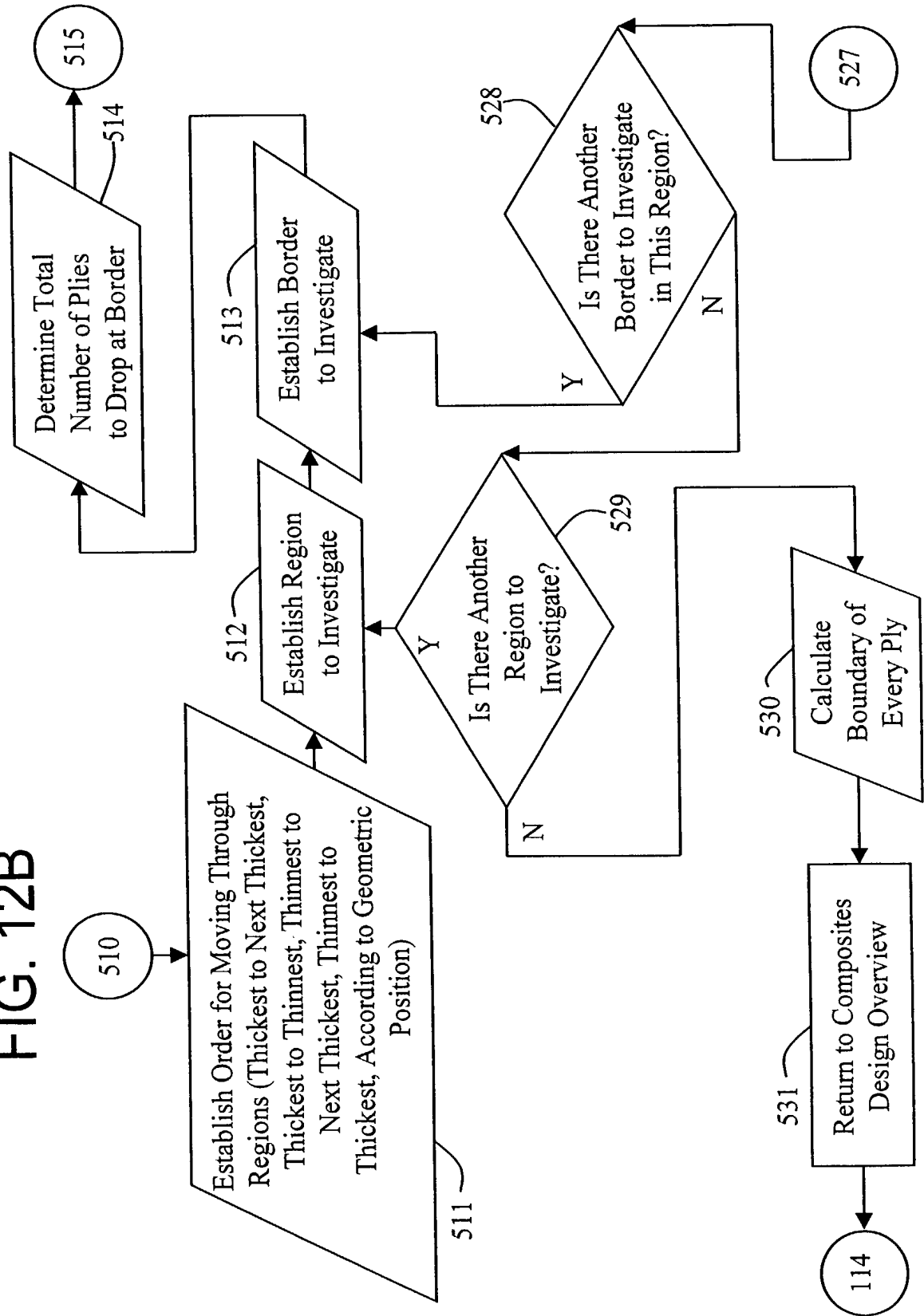


FIG. 12C

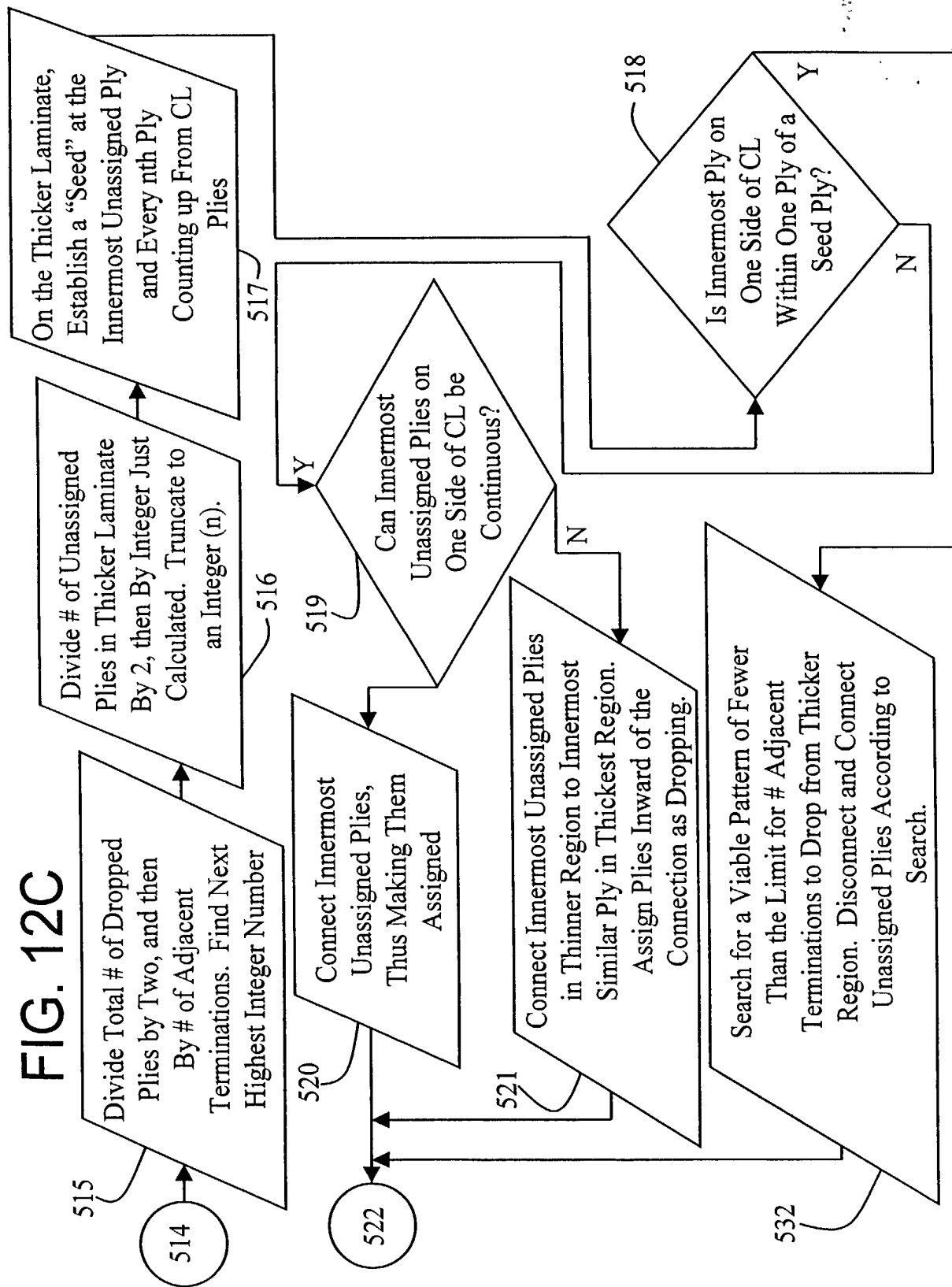


FIG. 12D

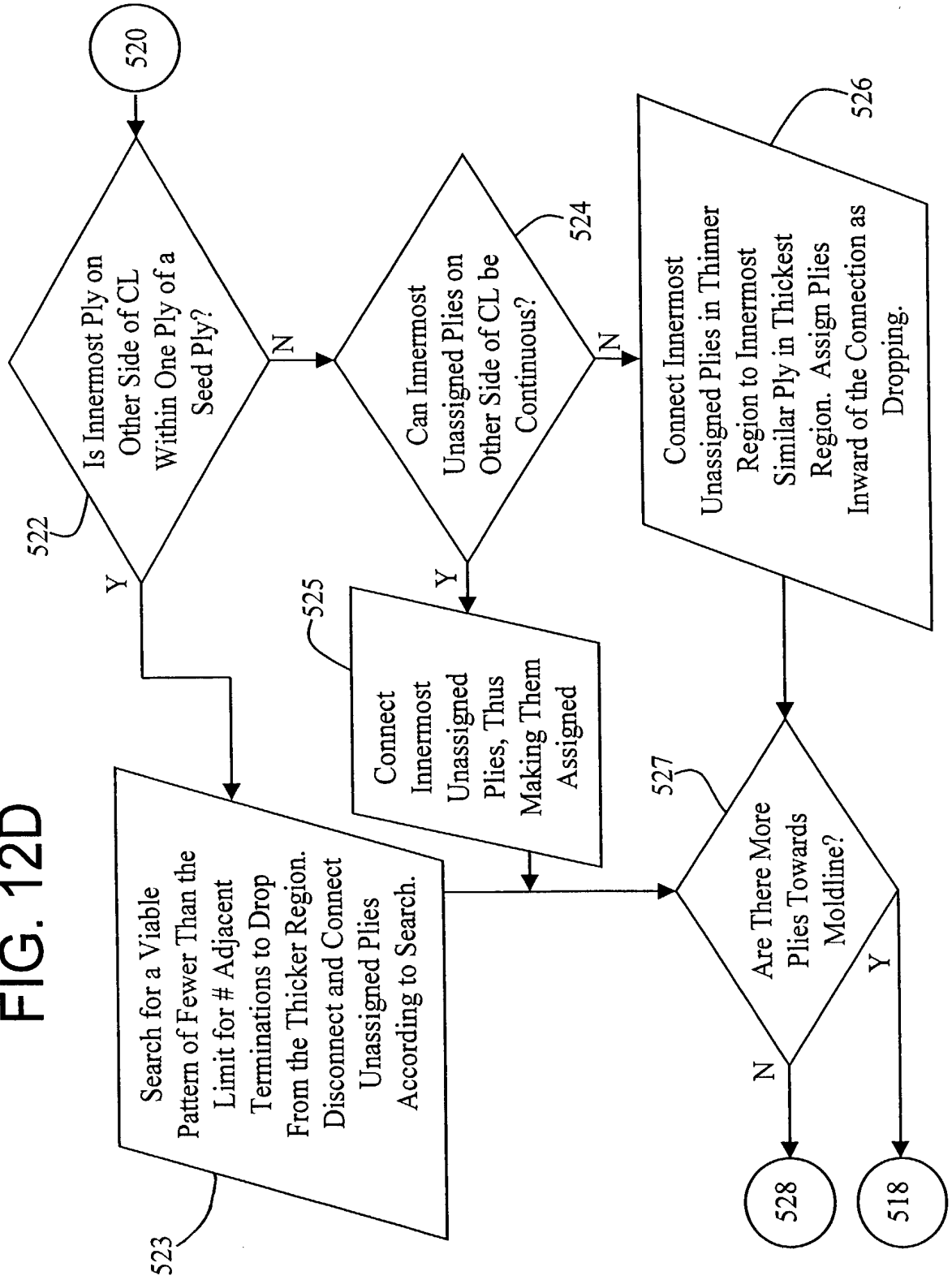




FIG. 13C

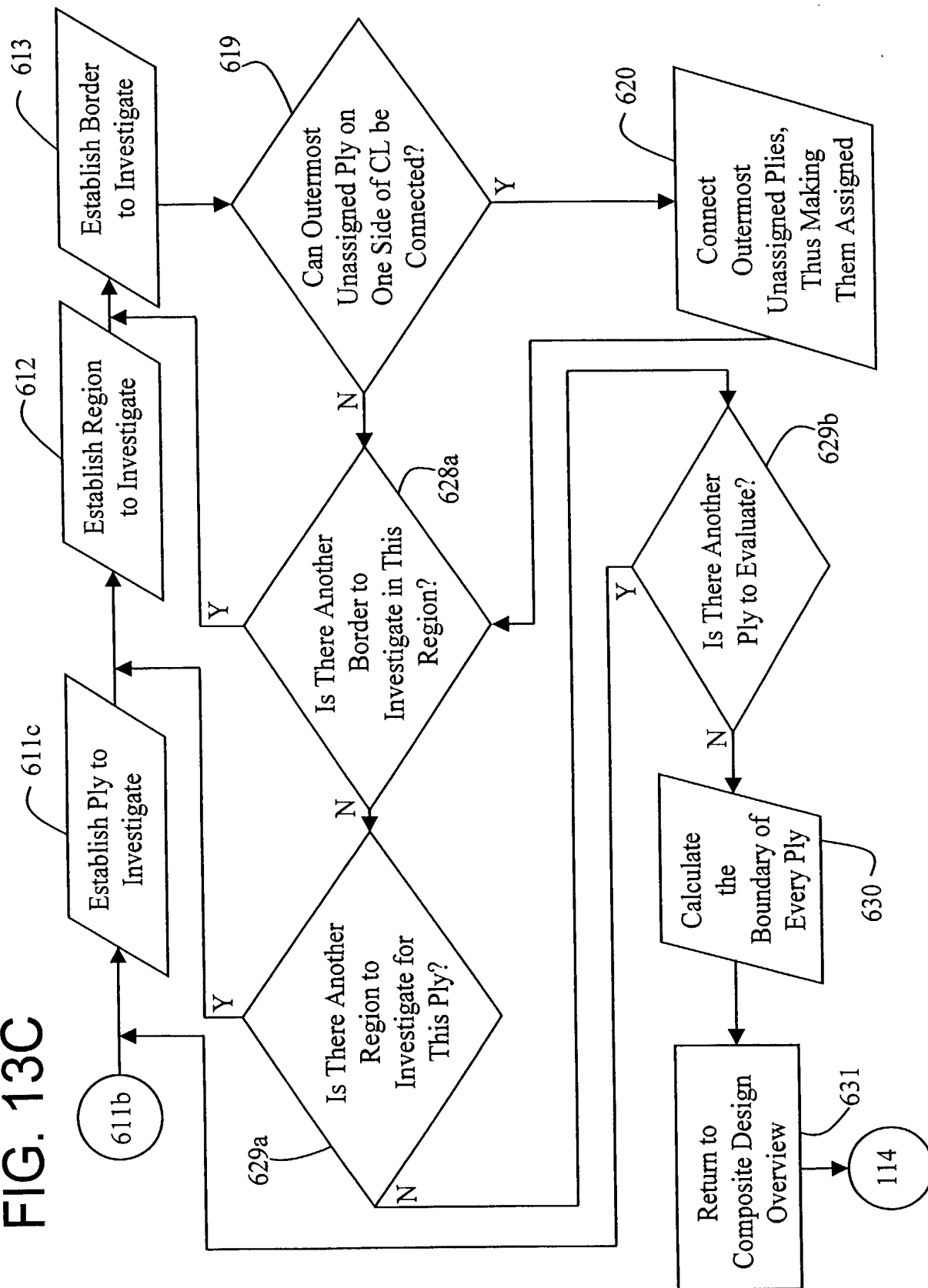
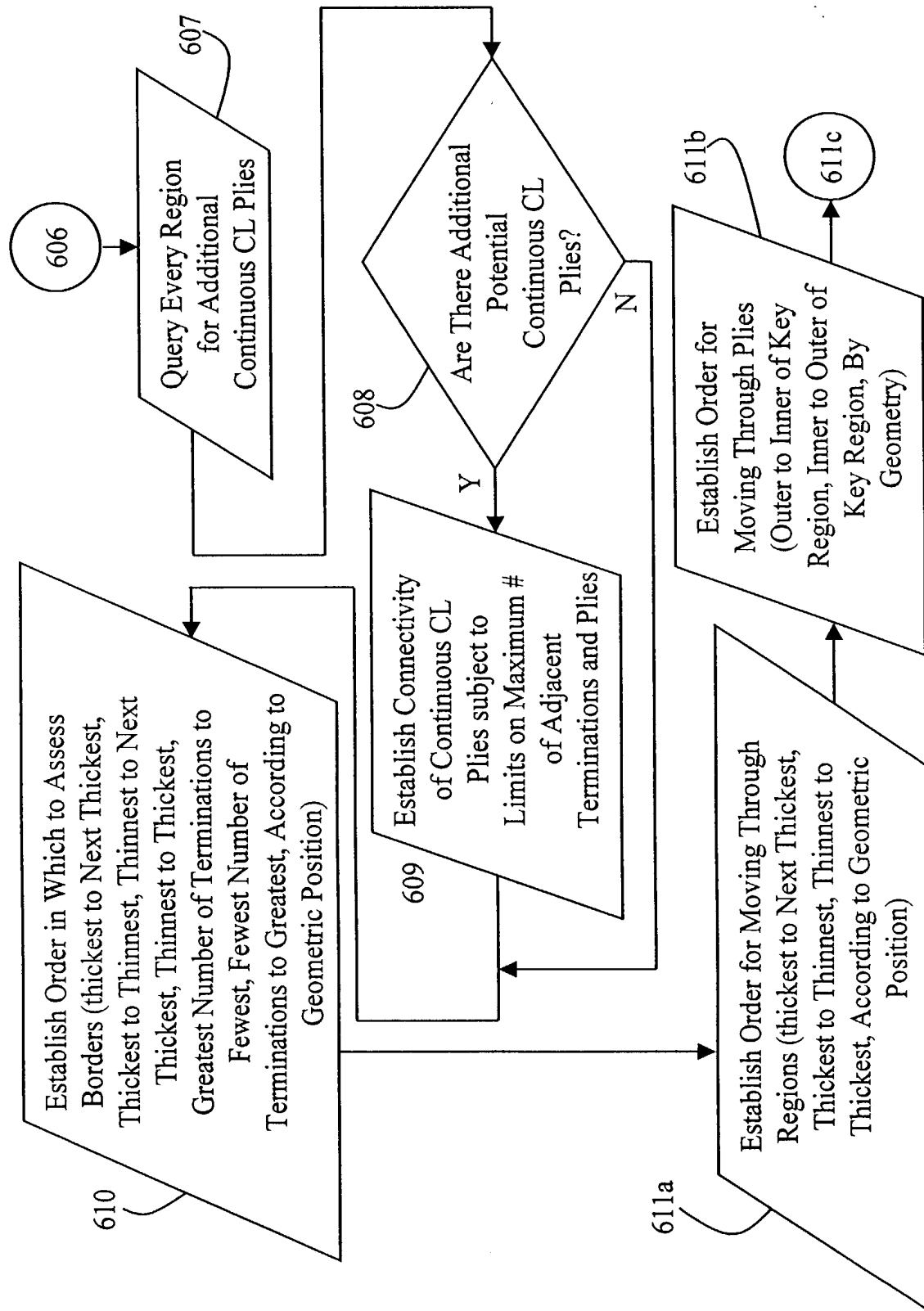




FIG. 13B



# FIG. 14A

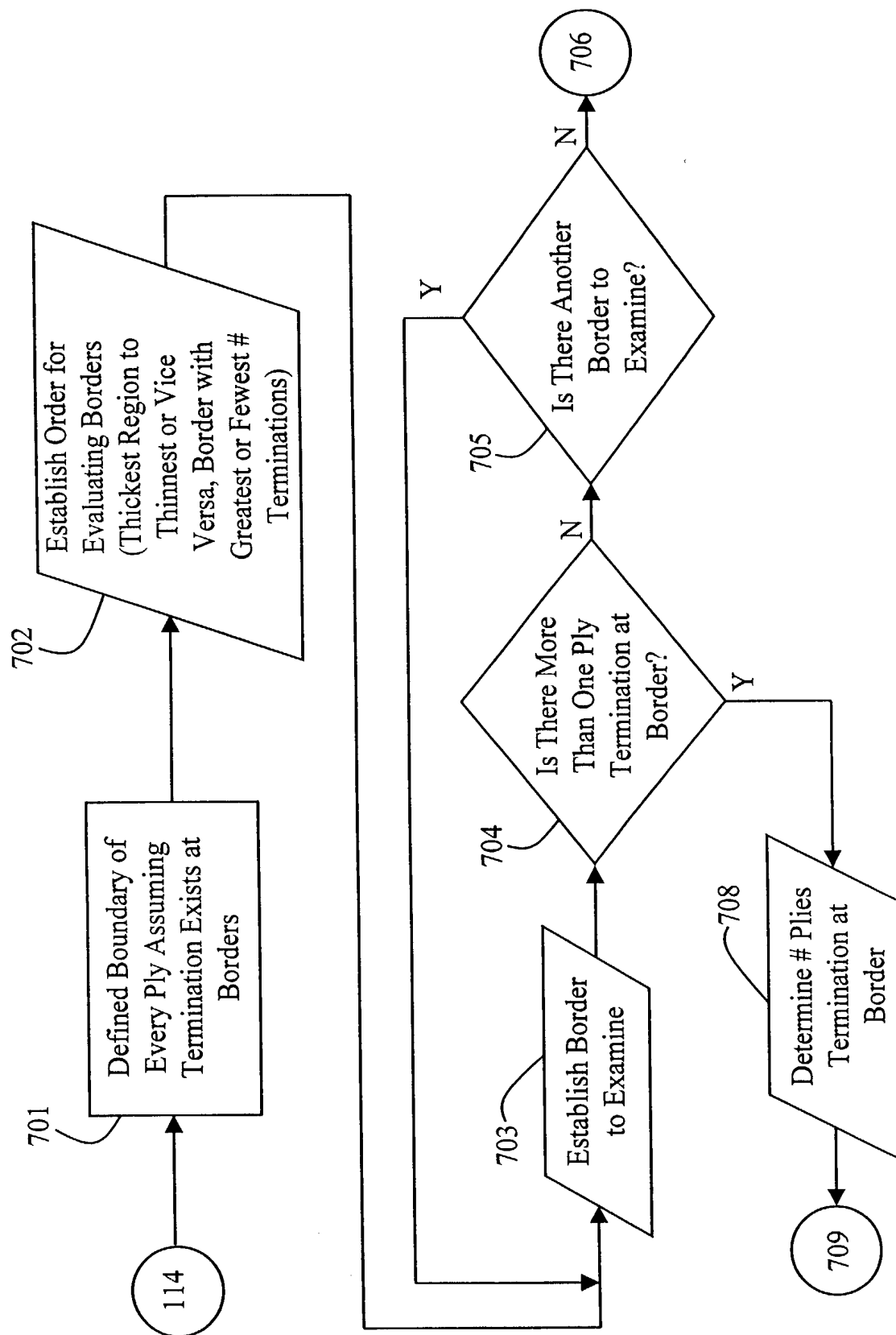


FIG. 14B

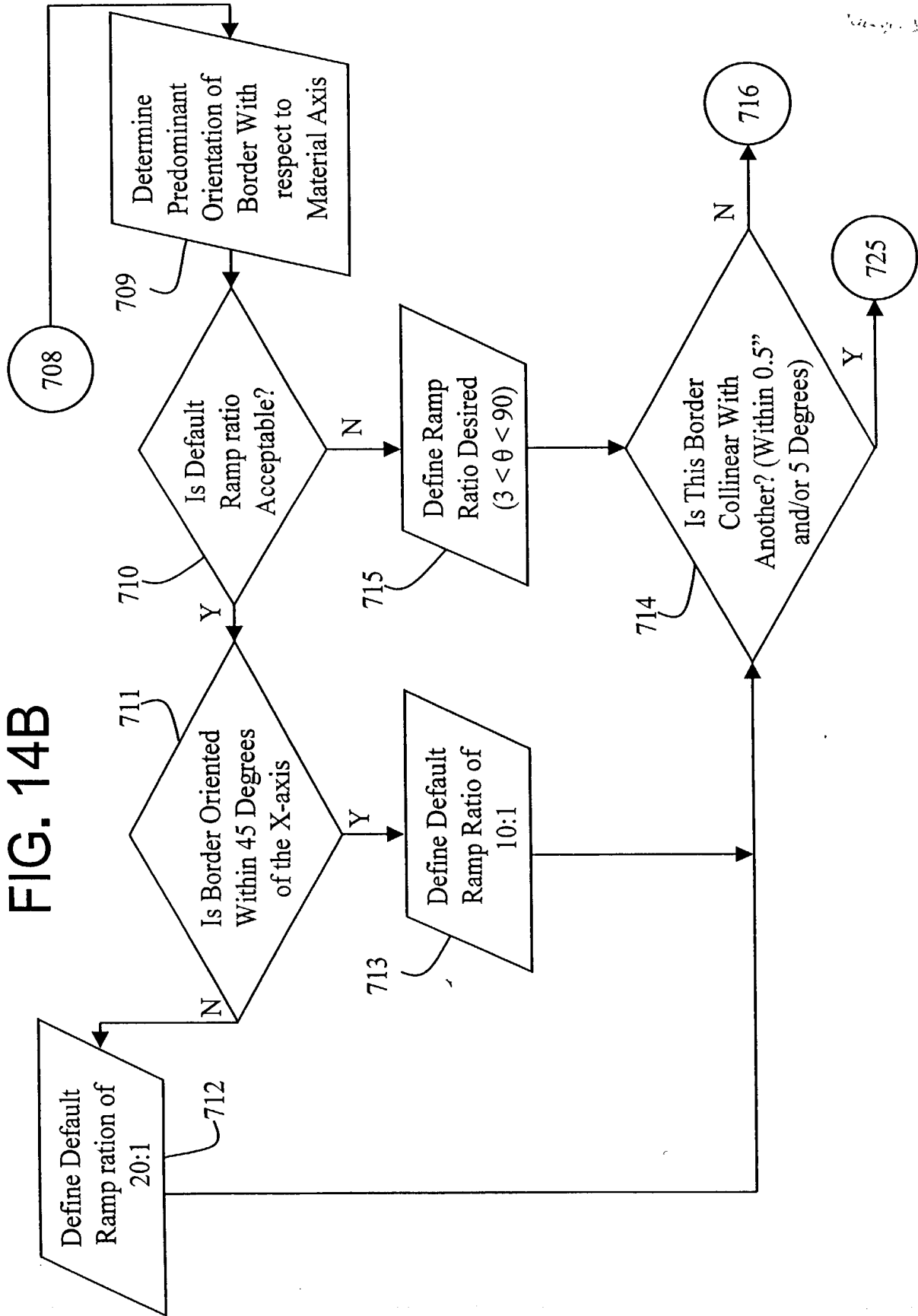


FIG. 14C

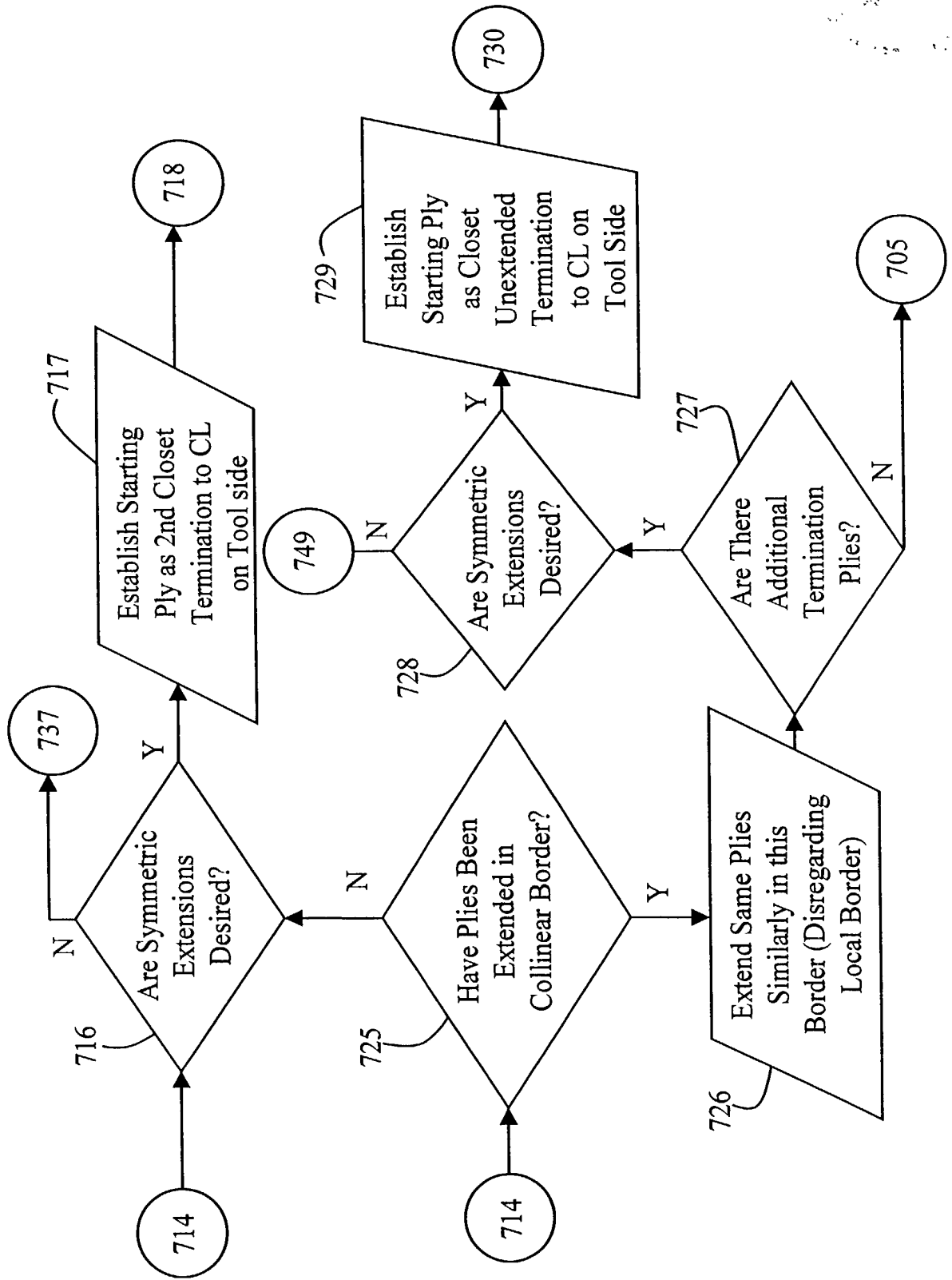


FIG.14D

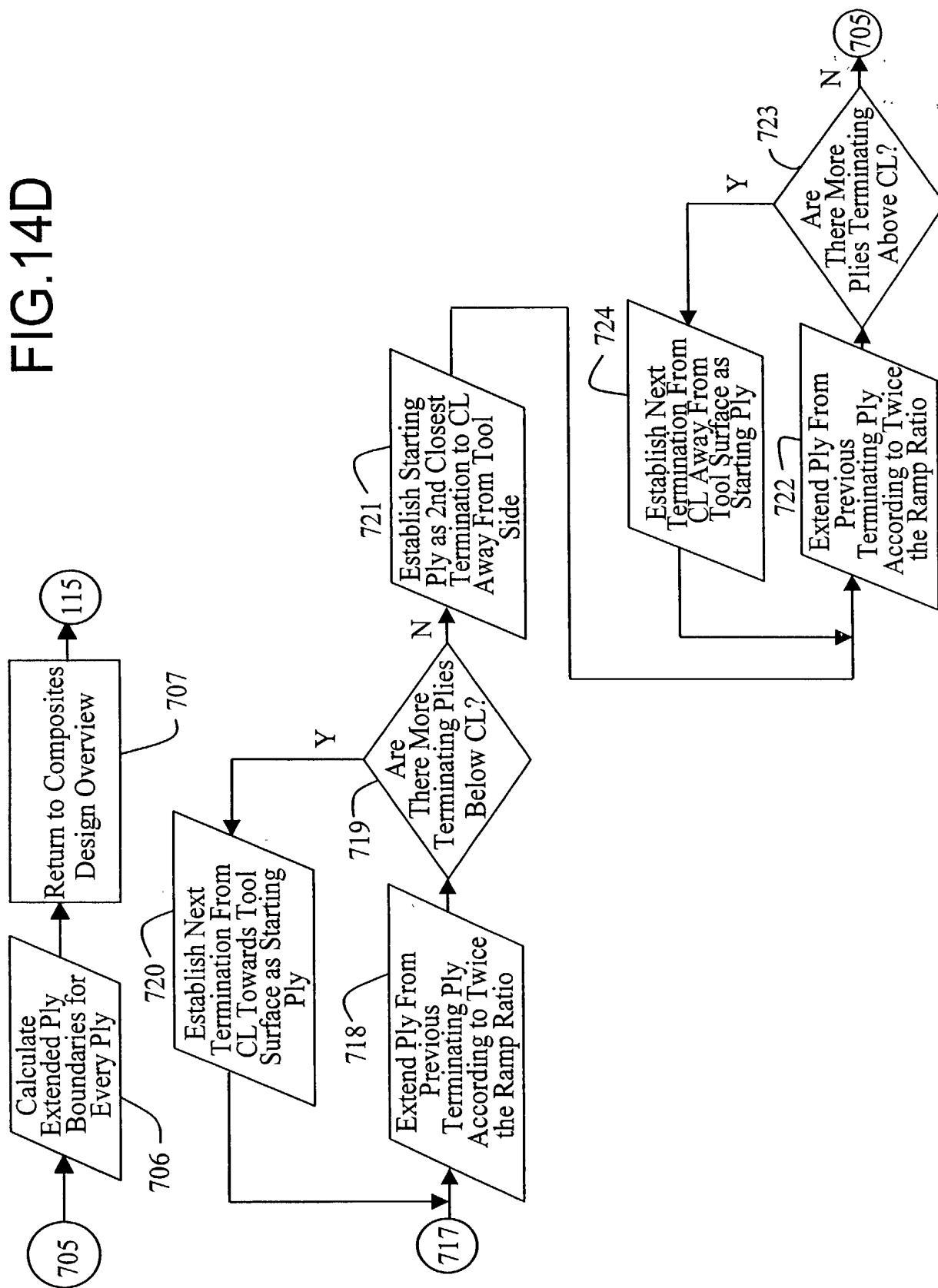


FIG. 14E

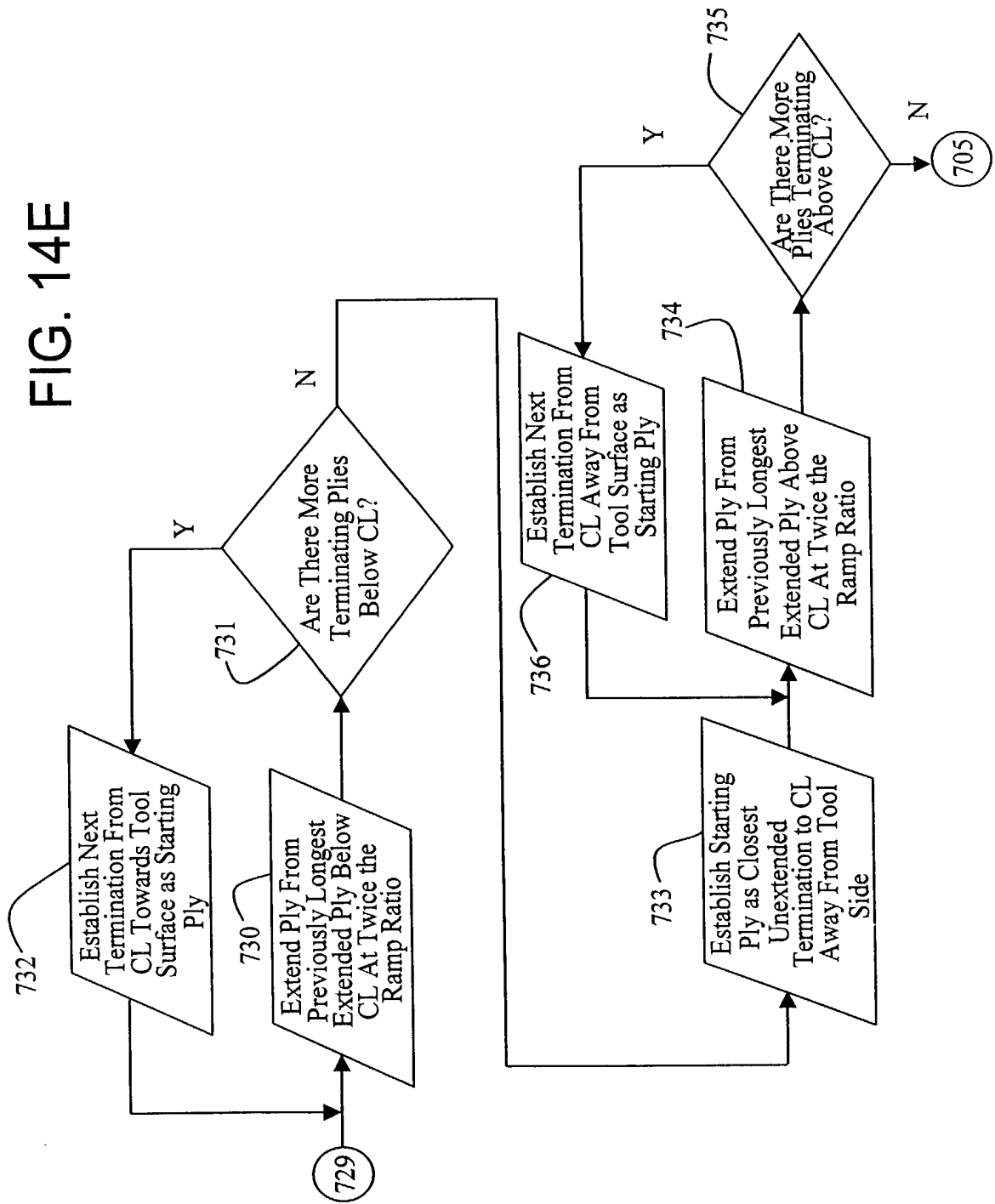


FIG. 14F

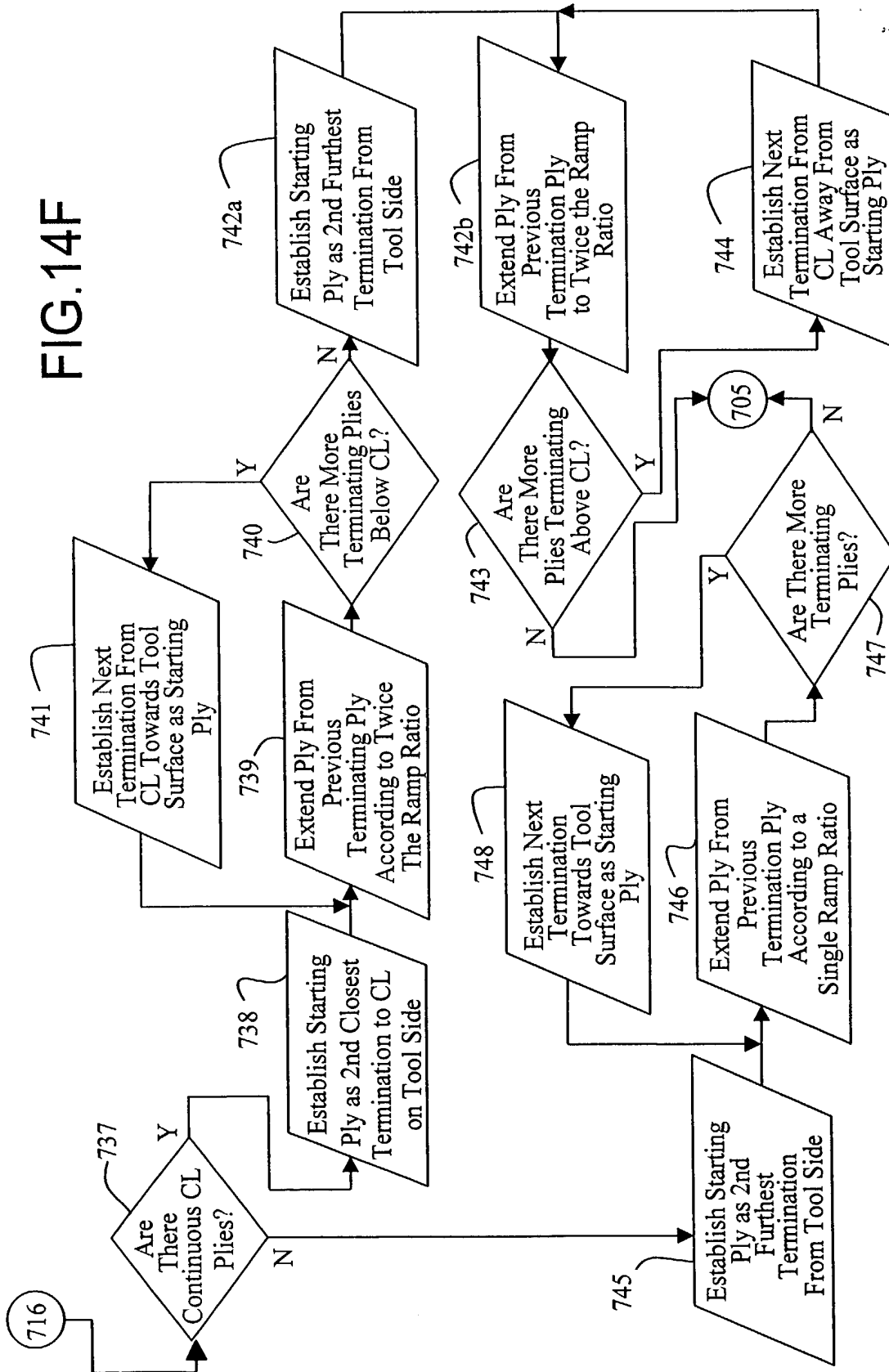
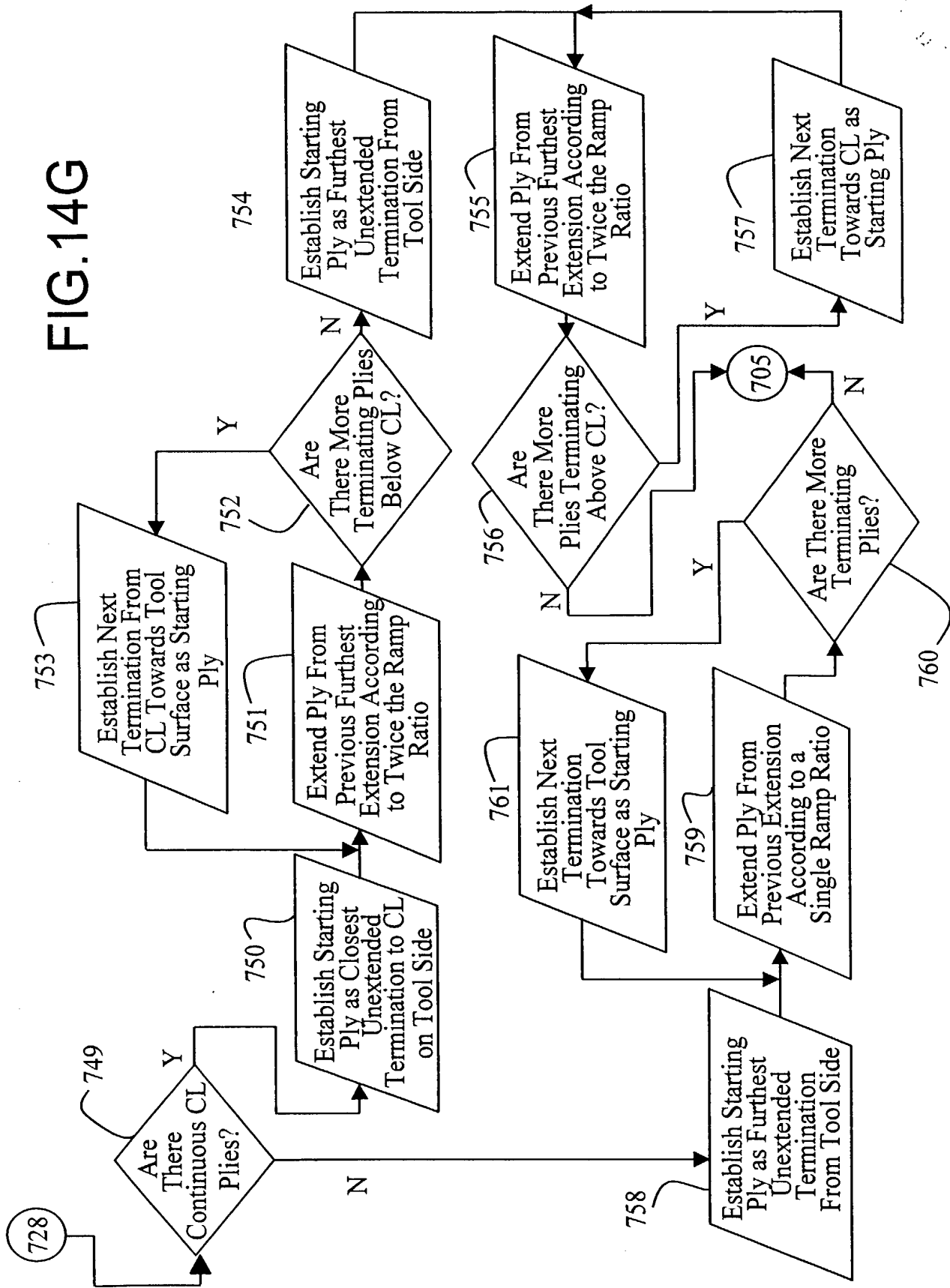


FIG. 14G





# FIG. 15A

801

User Inputs: Name of saved output file, Laminate thickness, Maximum allowed thickness, Ply thickness, Number of materials, Material properties (stiffness, poisson's ratio, thermal expansion coefficients, stress and strain allowables), Laminate family, Allowed variation in family, Extreme bounds on family, Number of similar adjacent plies allowed, Surface cloth material desired for moldline panels, Loading options, Failure criteria (Max. stress, max. strain, Tsai-Hill, Bearing-Bypass), Number of load cases, Load angle with respect to material axis, In-plane loads and moments, Pressure on panel, Panel Geometry, Data reduction flags (number of desired solutions based on strength or stiffness requirements -- for strength the most positive safety margin, the least positive safety margin and a defined number of intermediate solutions; for stiffness the most and least stiff and a defined number of intermediate solutions for each primary stiffness).

122

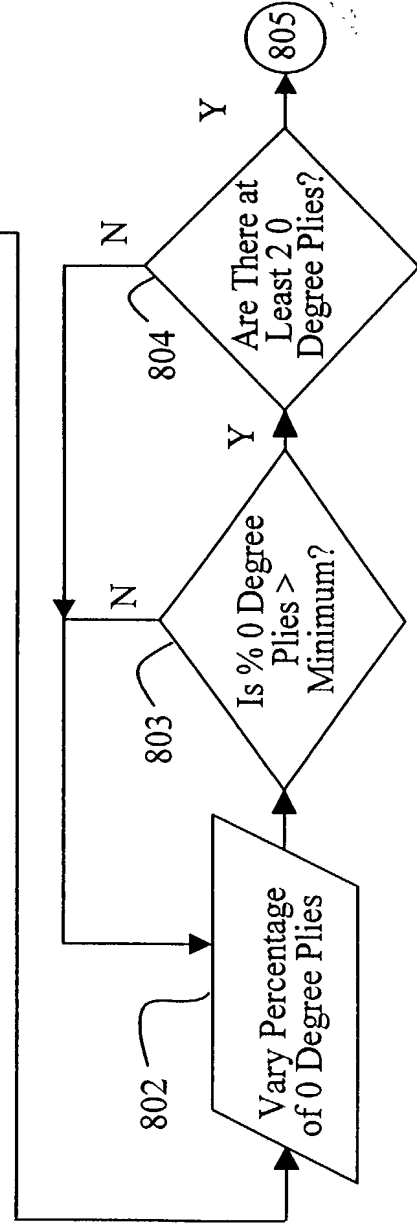




FIG. 15C

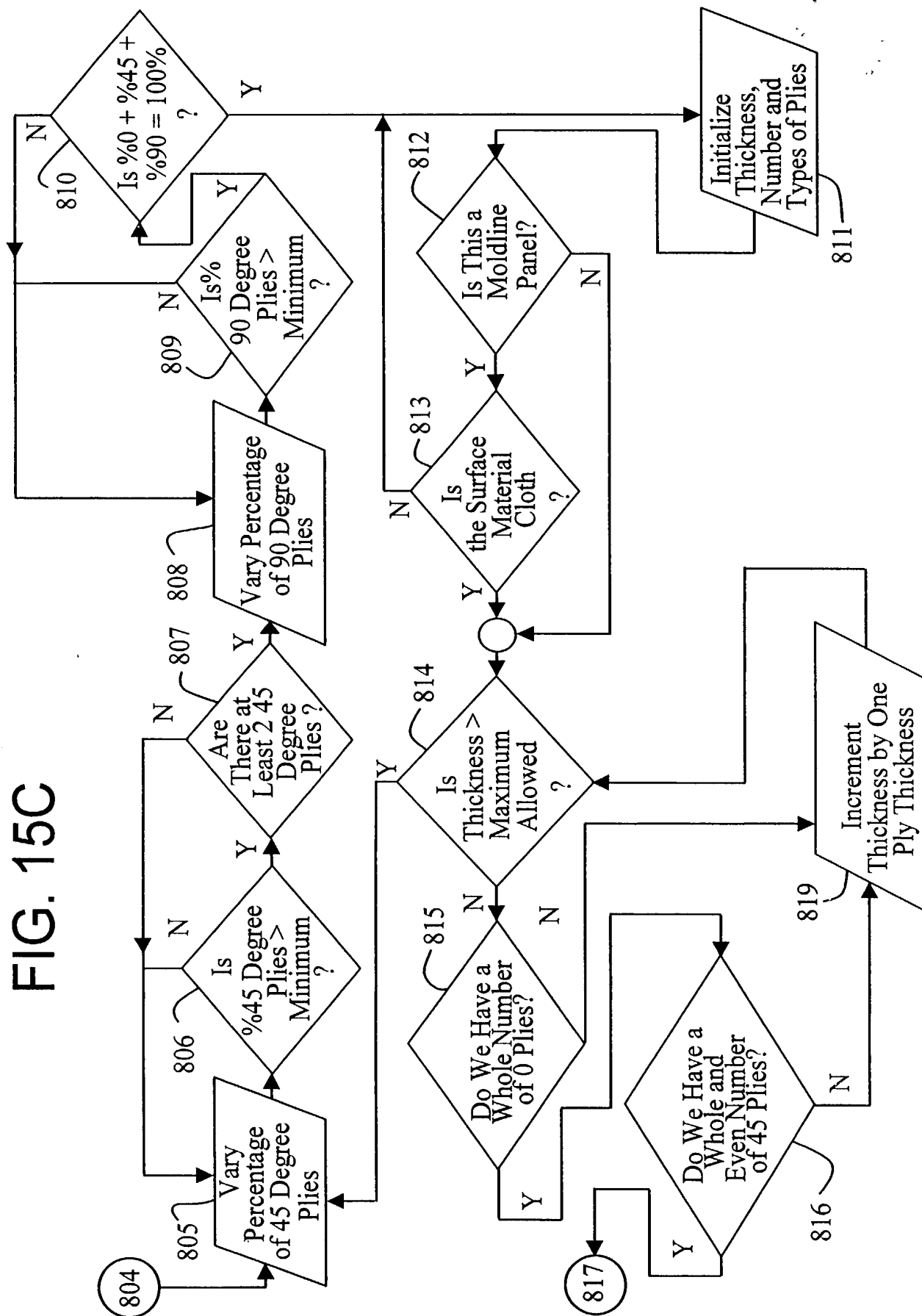


FIG. 15D

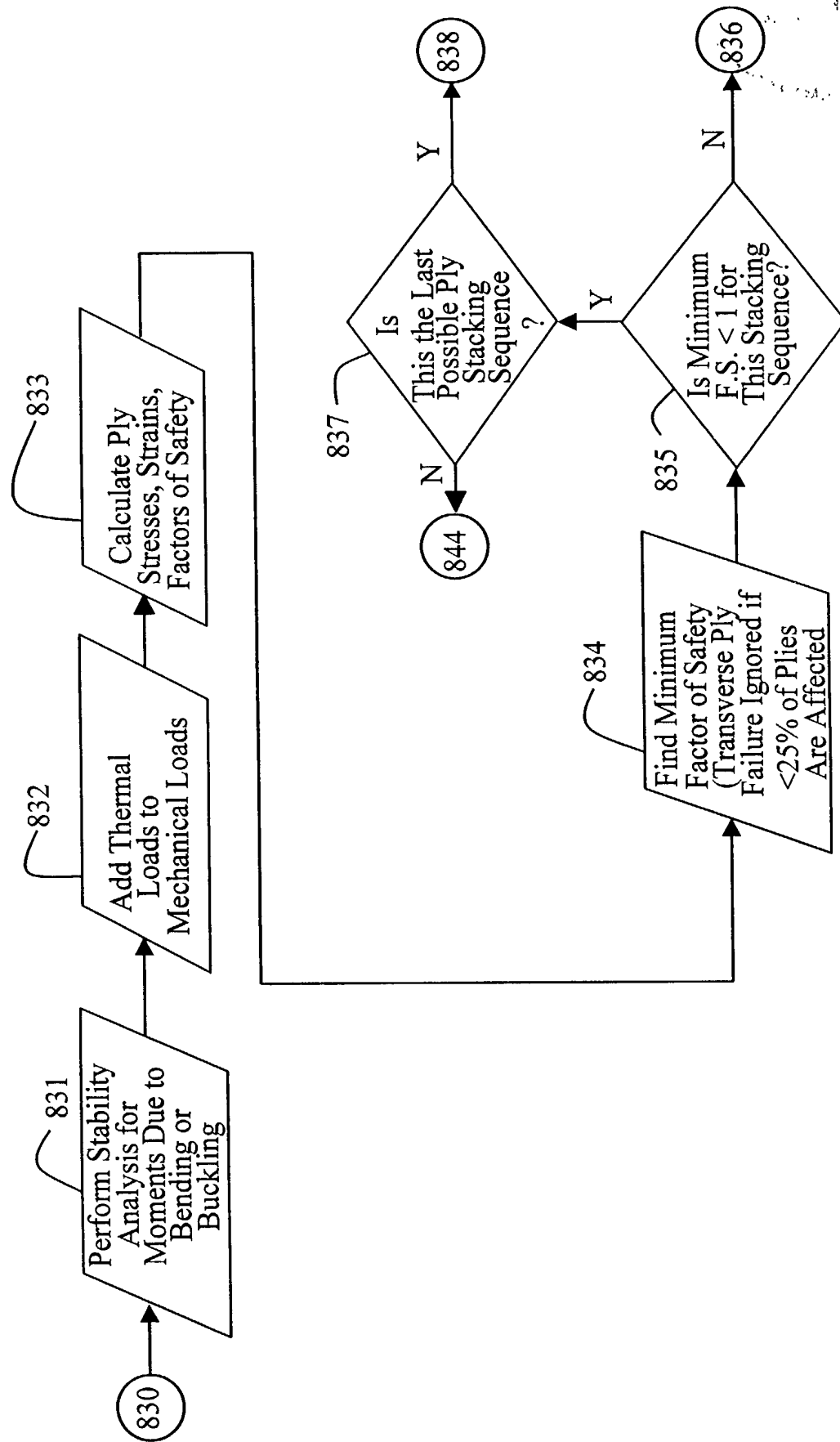


FIG. 15E

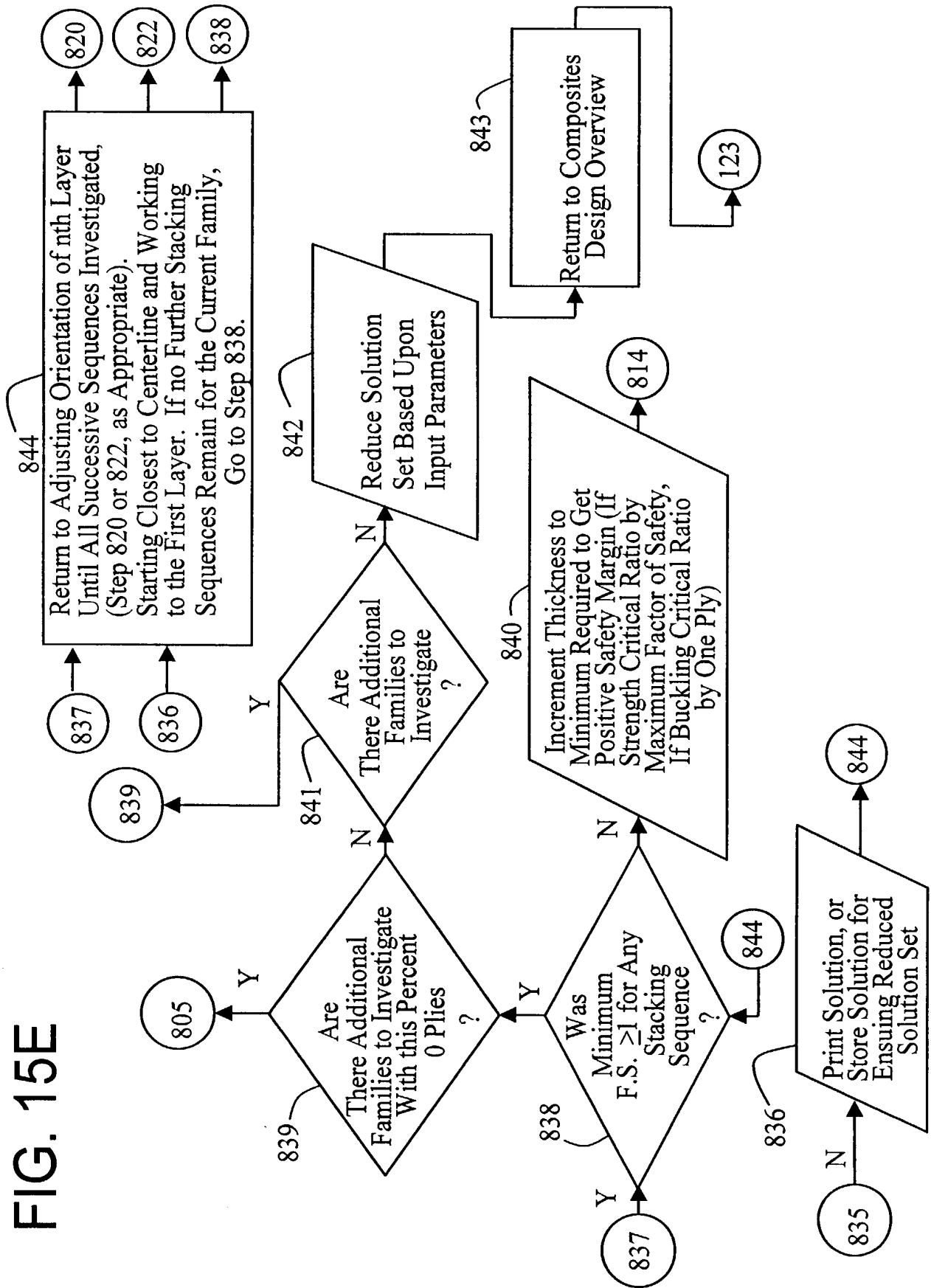




FIG. 17A

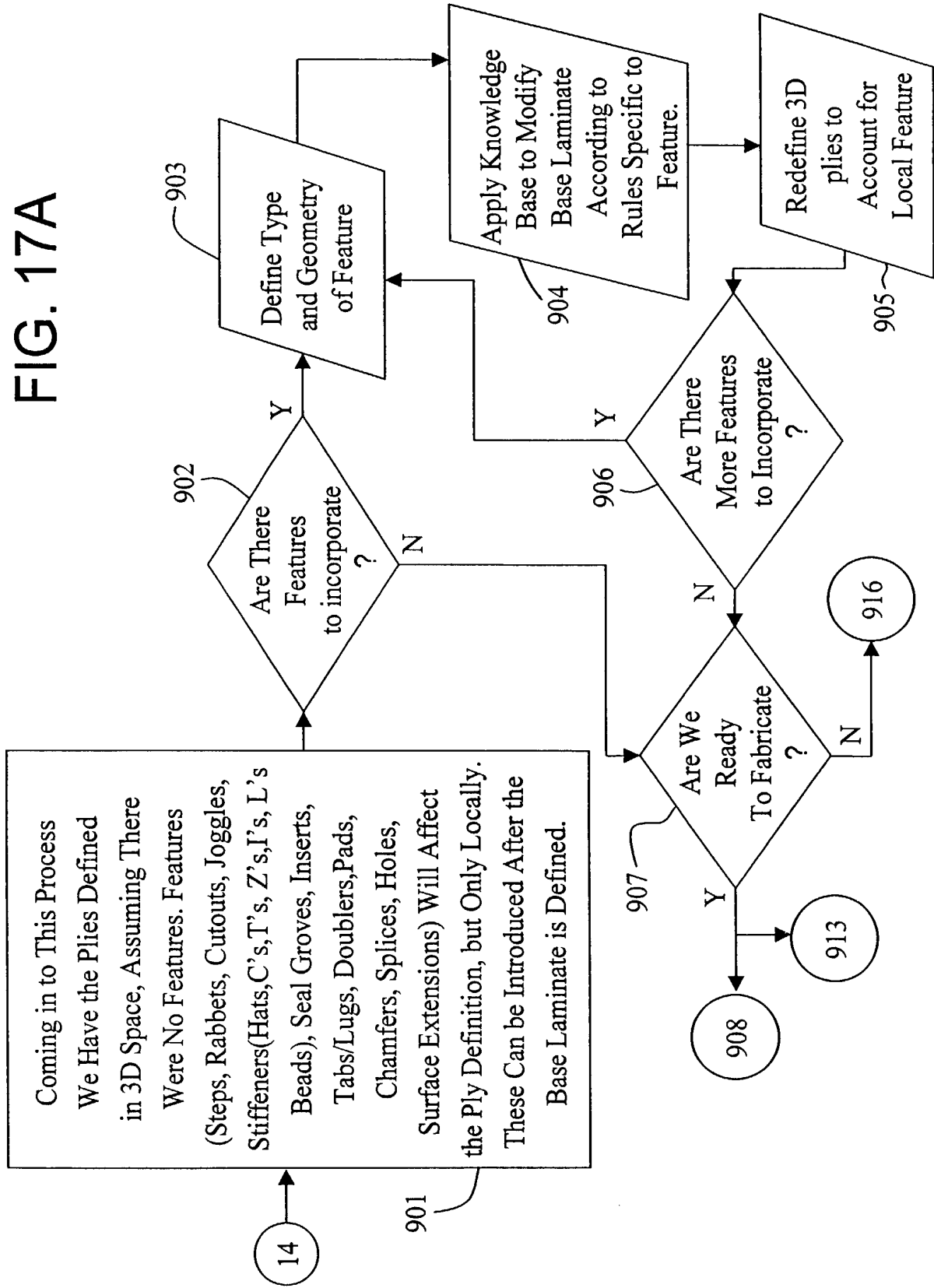


FIG. 17B

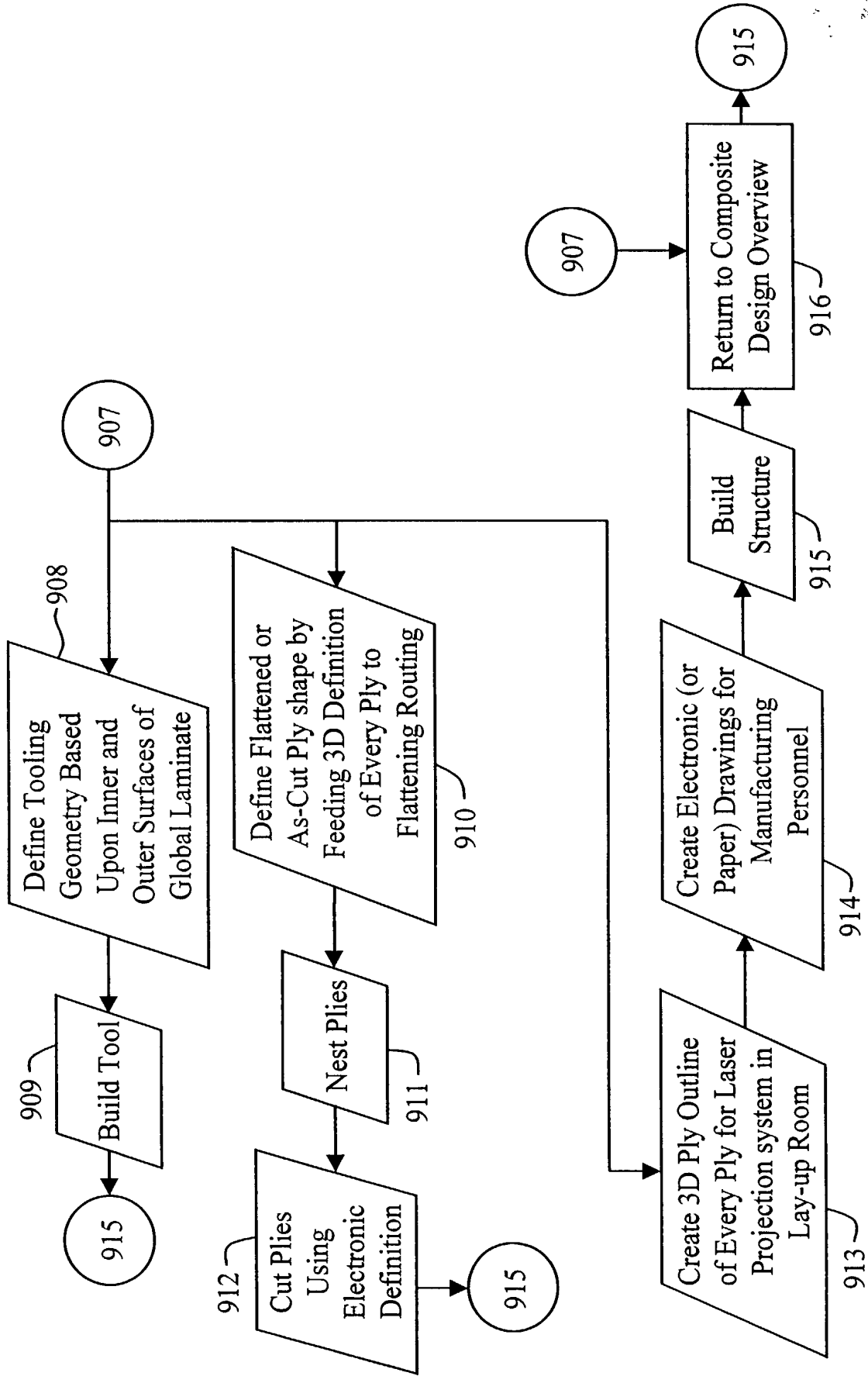






FIG. 19

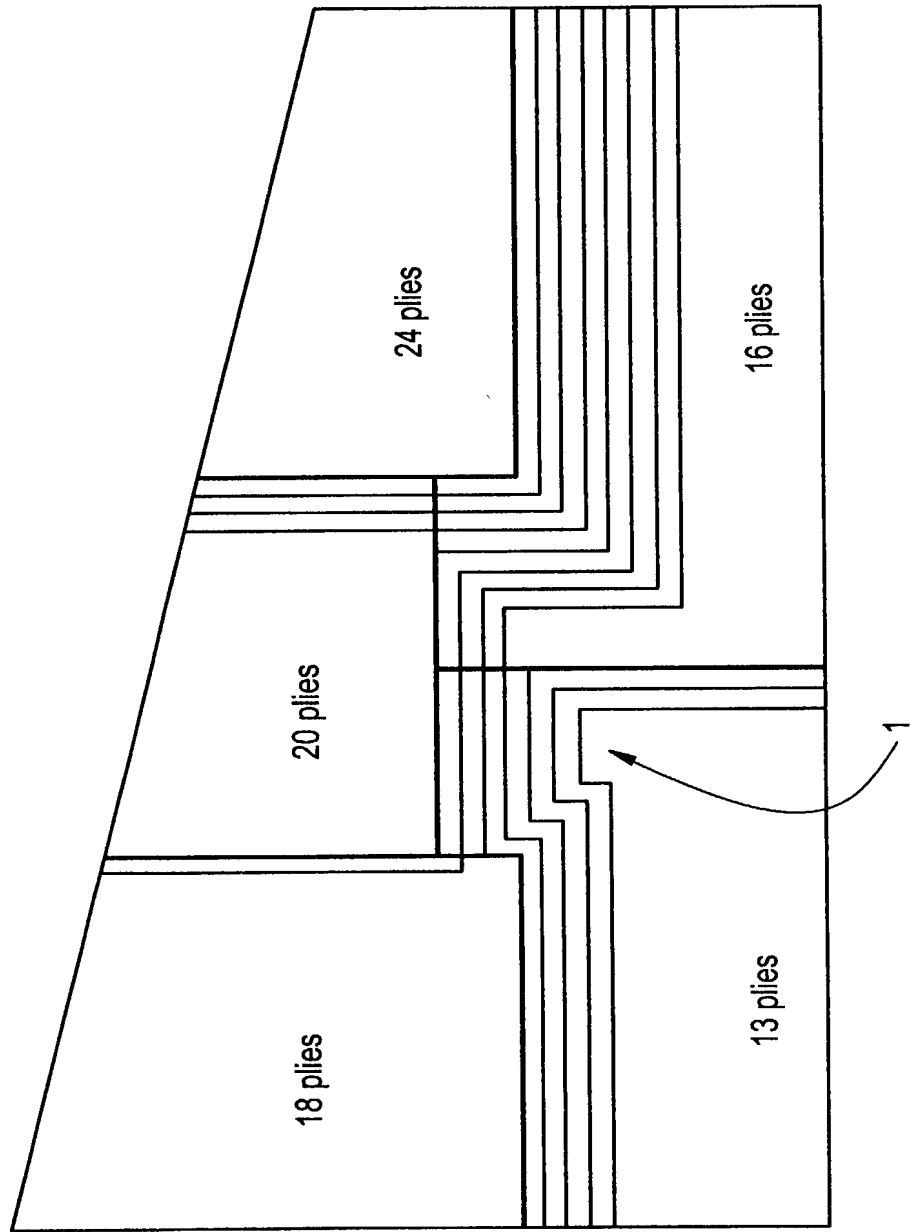


FIG. 20

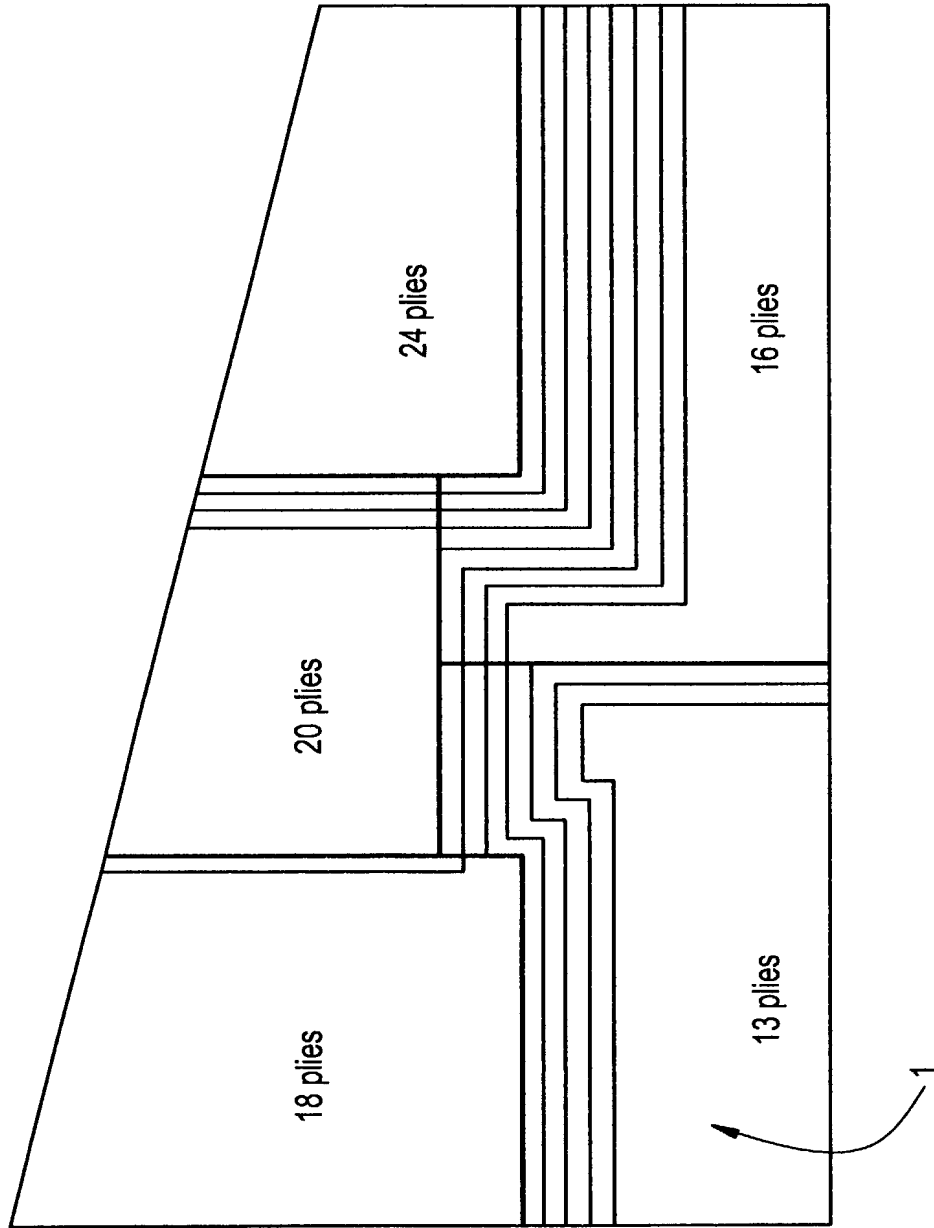
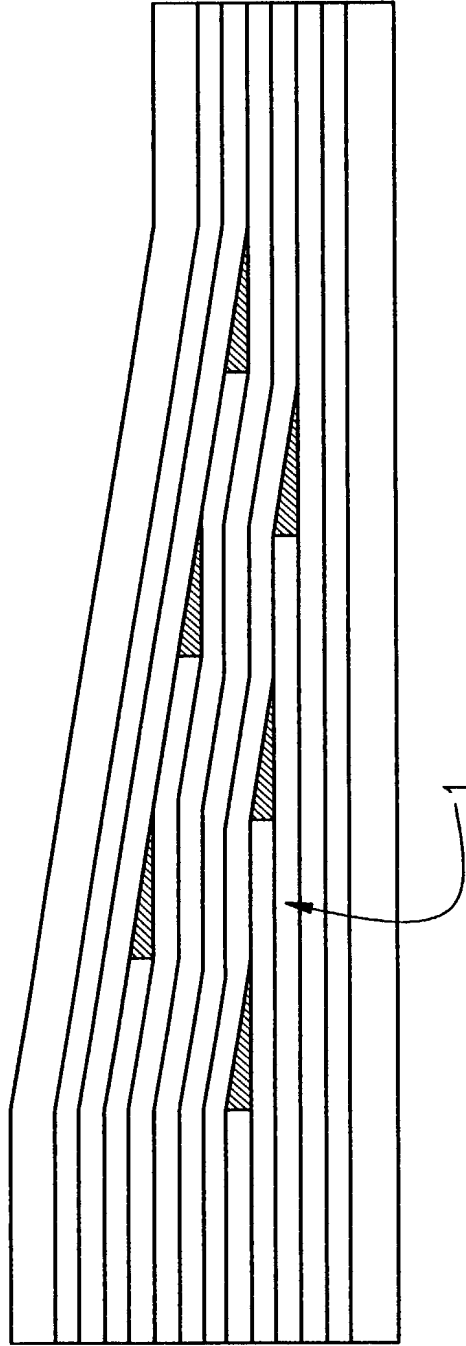


FIG. 21



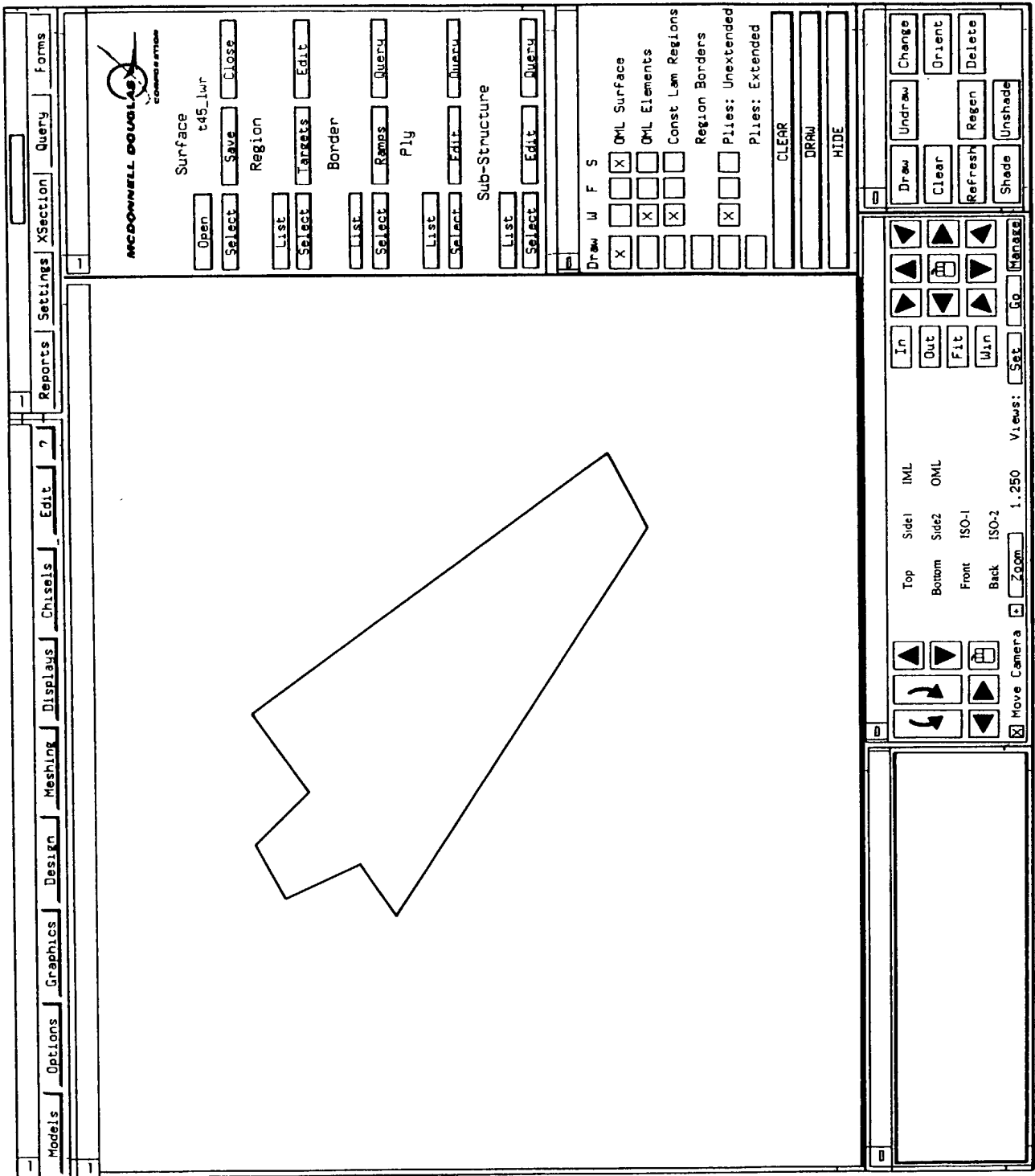
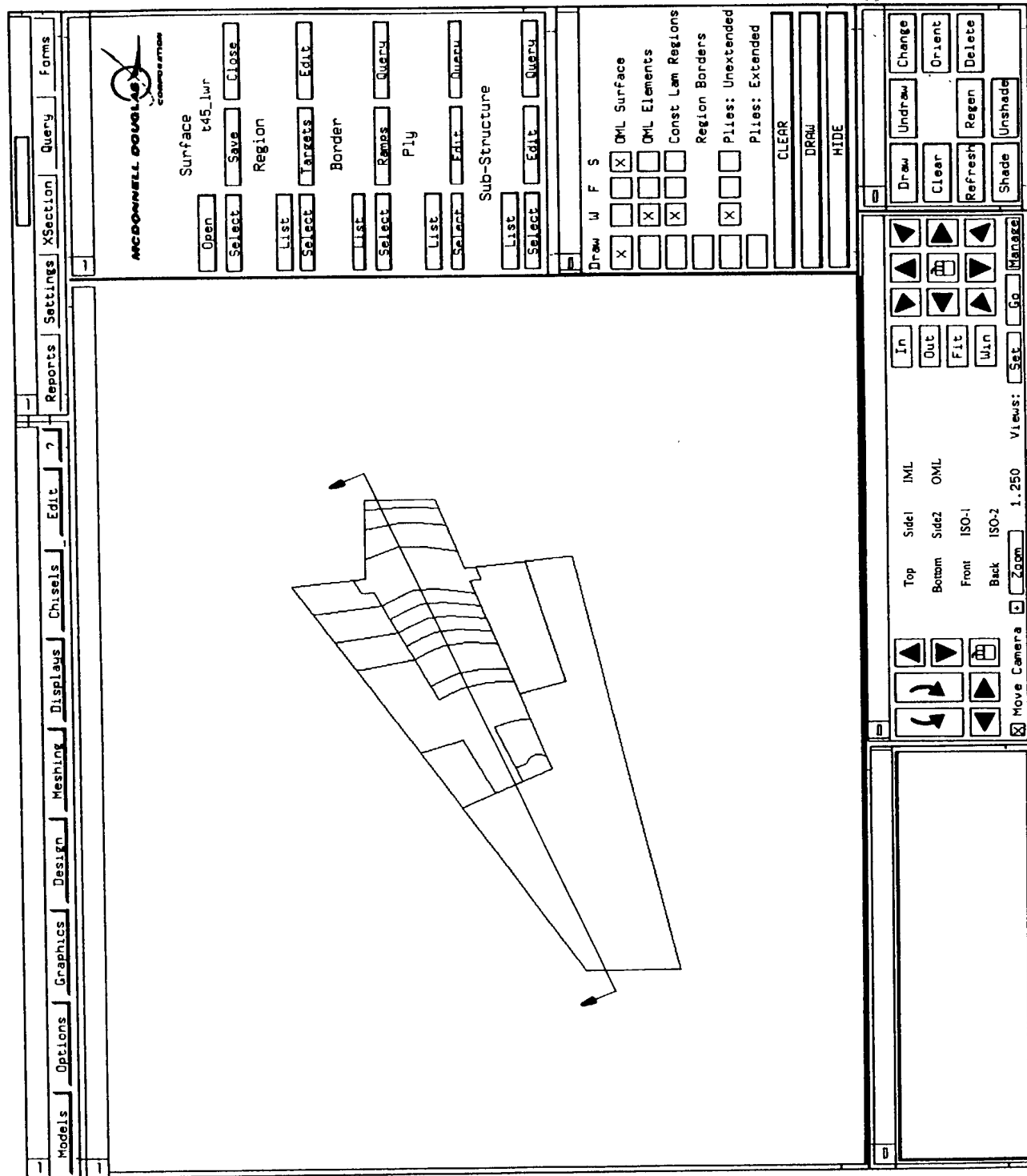


FIG. 23



McDonnell Douglas Command & Motion

Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

Surface  
t45\_lwr

Open  Save  Close

Region  
List  Select  Targets  Edit

Border  
List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

Draw W F S

X ☐ ☐ ☐ ☒ OML Surface

X ☐ ☐ ☐ ☐ OML Elements

X ☐ ☐ ☐ ☐ Const Lam Regions

Region Borders  
X ☐ ☐ ☐ ☐ Plies: Unextended

Plies: Extended  
CLEAR

DRAW

HIDE

Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

Surface  
t45\_lwr

Open  Save  Close

Region  
List  Select  Targets  Edit

Border  
List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

Draw W F S

X ☐ ☐ ☐ ☒ OML Surface

X ☐ ☐ ☐ ☐ OML Elements

X ☐ ☐ ☐ ☐ Const Lam Regions

Region Borders  
X ☐ ☐ ☐ ☐ Plies: Unextended

Plies: Extended  
CLEAR

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Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

Surface  
t45\_lwr

Open  Save  Close

Region  
List  Select  Targets  Edit

Border  
List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

Draw W F S

X ☐ ☐ ☐ ☒ OML Surface

X ☐ ☐ ☐ ☐ OML Elements

X ☐ ☐ ☐ ☐ Const Lam Regions

Region Borders  
X ☐ ☐ ☐ ☐ Plies: Unextended

Plies: Extended  
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Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

Surface  
t45\_lwr

Open  Save  Close

Region  
List  Select  Targets  Edit

Border  
List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

Draw W F S

X ☐ ☐ ☐ ☒ OML Surface

X ☐ ☐ ☐ ☐ OML Elements

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Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
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List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

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X ☐ ☐ ☐ ☐ OML Elements

X ☐ ☐ ☐ ☐ Const Lam Regions

Region Borders  
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Plies: Extended  
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DRAW

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Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

Surface  
t45\_lwr

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Region  
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Border  
List  Select  Remaps  Query

Ply  
List  Select  Edit  Queue

Sub-Structure  
List  Select  Edit  Query

Draw W F S

X ☐ ☐ ☐ ☒ OML Surface

X ☐ ☐ ☐ ☐ OML Elements

X ☐ ☐ ☐ ☐ Const Lam Regions

Region Borders  
X ☐ ☐ ☐ ☐ Plies: Unextended

Plies: Extended  
CLEAR

DRAW

HIDE

Models Options Graphics Design Meshing Displays Chisels Edit 7 Reports Settings XSection Query Forms

**McDONNELL DOUGLAS**  
COMPONENTS

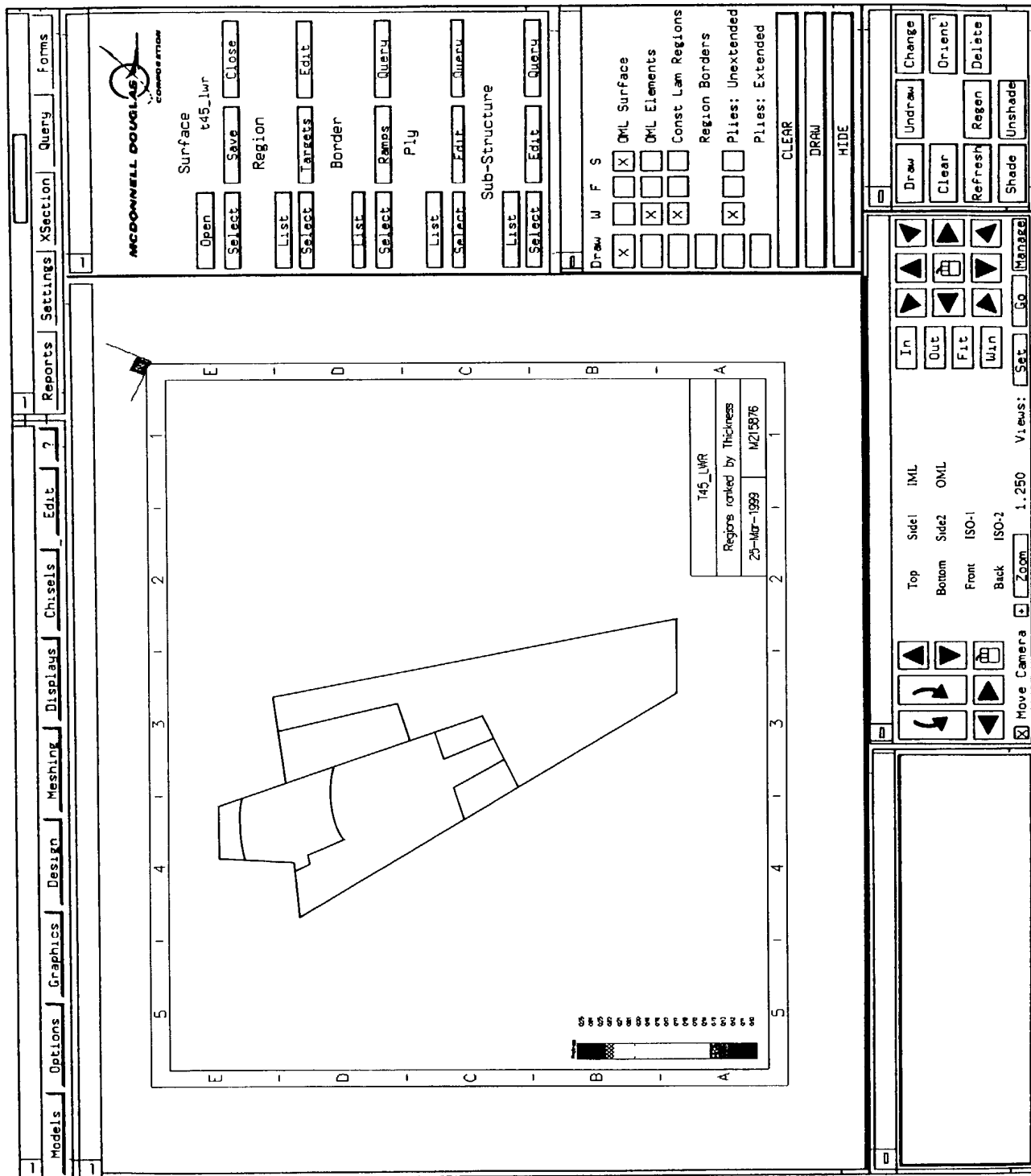
Surface  
t45\_l

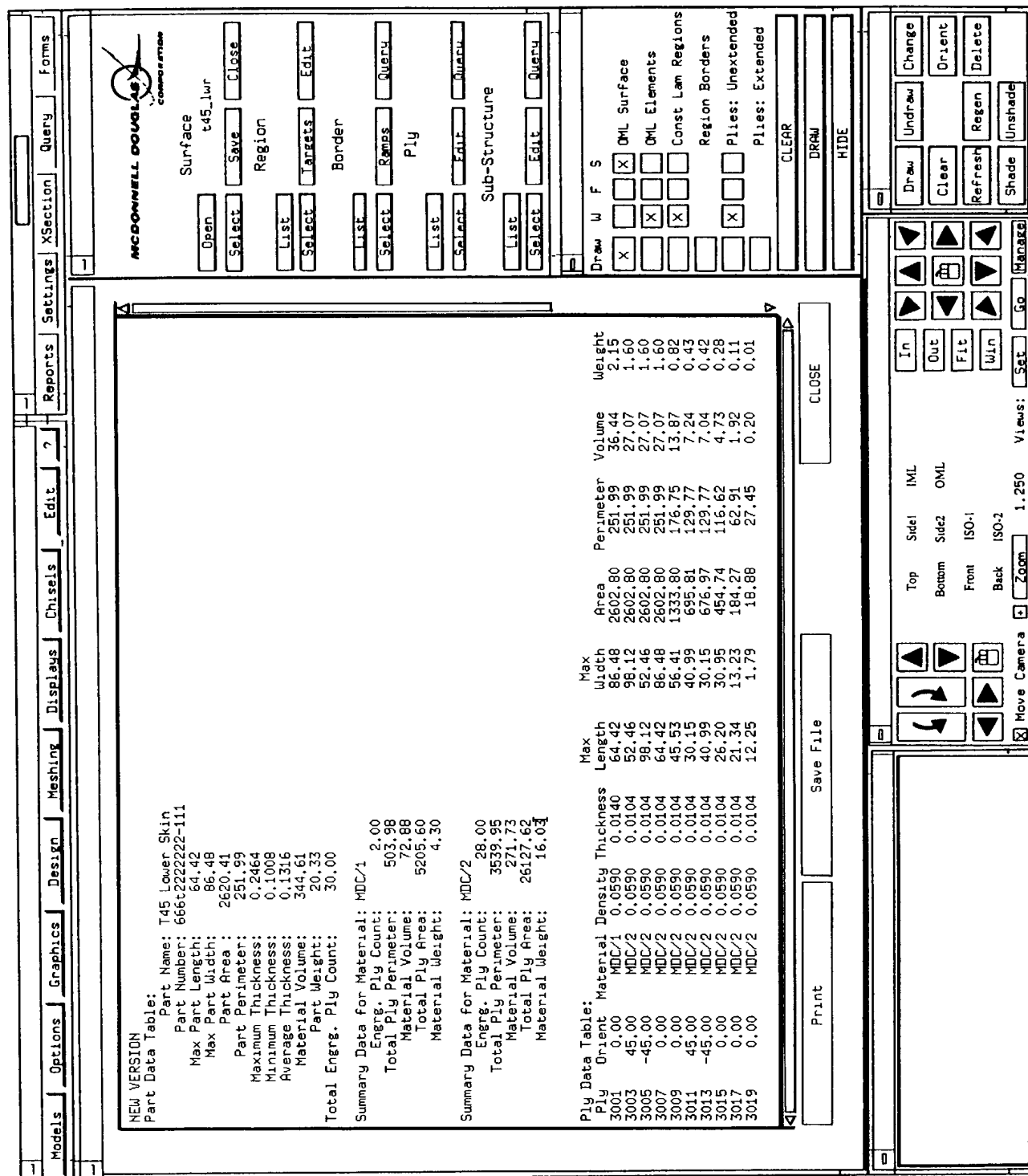
[illegible]

[illegible][illegible]



FIG.26



$$\left\{ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix} \right\}, \left\{ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \right\}, \left\{ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \right\}$$


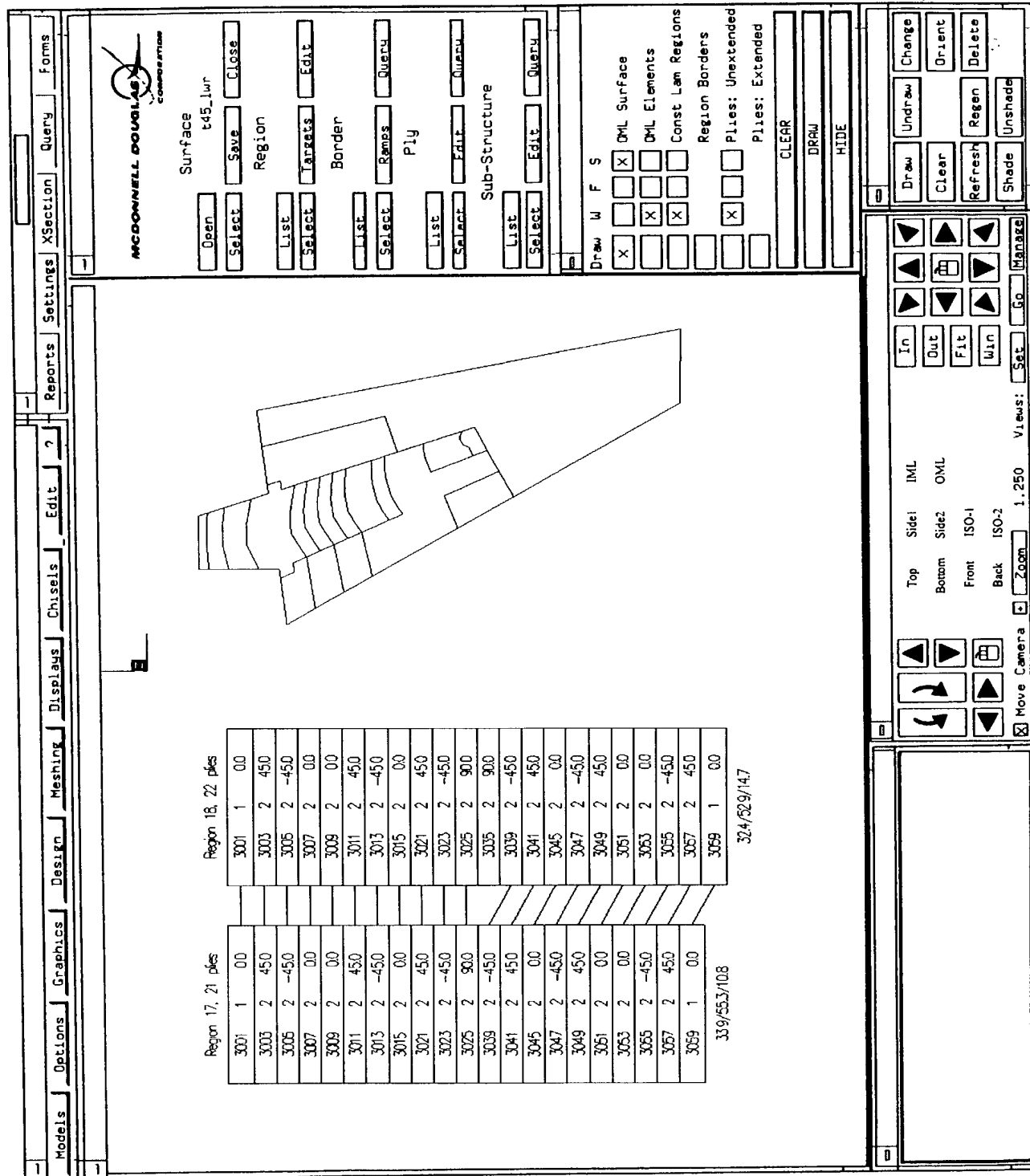
[illegible]

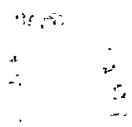
3

FIG. 29

[illegible]

FIG. 31



$$\left\{ \begin{array}{c} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \\ x_{10} \\ x_{11} \\ x_{12} \\ x_{13} \\ x_{14} \\ x_{15} \\ x_{16} \\ x_{17} \\ x_{18} \\ x_{19} \\ x_{20} \\ x_{21} \\ x_{22} \\ x_{23} \\ x_{24} \\ x_{25} \\ x_{26} \\ x_{27} \\ x_{28} \\ x_{29} \\ x_{30} \\ x_{31} \\ x_{32} \\ x_{33} \\ x_{34} \\ x_{35} \\ x_{36} \\ x_{37} \\ x_{38} \\ x_{39} \\ x_{40} \\ x_{41} \\ x_{42} \\ x_{43} \\ x_{44} \\ x_{45} \\ x_{46} \\ x_{47} \\ x_{48} \\ x_{49} \\ x_{50} \\ x_{51} \\ x_{52} \\ x_{53} \\ x_{54} \\ x_{55} \\ x_{56} \\ x_{57} \\ x_{58} \\ x_{59} \\ x_{60} \\ x_{61} \\ x_{62} \\ x_{63} \\ x_{64} \\ x_{65} \\ x_{66} \\ x_{67} \\ x_{68} \\ x_{69} \\ x_{70} \\ x_{71} \\ x_{72} \\ x_{73} \\ x_{74} \\ x_{75} \\ x_{76} \\ x_{77} \\ x_{78} \\ x_{79} \\ x_{80} \\ x_{81} \\ x_{82} \\ x_{83} \\ x_{84} \\ x_{85} \\ x_{86} \\ x_{87} \\ x_{88} \\ x_{89} \\ x_{90} \\ x_{91} \\ x_{92} \\ x_{93} \\ x_{94} \\ x_{95} \\ x_{96} \\ x_{97} \\ x_{98} \\ x_{99} \\ x_{100} \end{array} \right\}$$


Laminate Designer			
Region:	1		
Thickness:	0.1248		
Thickness Bound:	0.1248		
Target Family:	50.0/40.0/10.0		
Variation in 0/+45/90:	5.0/ 5.0/ 5.0		
Minimum Bound:	7.0		
Maximum Bound:	55.0		
Adjacent Plies Allowed:			
# Within Laminate:	2		
# At Centerline:	2		
Material:	<input type="checkbox"/> MDC/1		
Material at Surface:	<input type="checkbox"/> MDC/1		
Apply Loads:	<input type="checkbox"/> No		
# Stiffness Targets:	3		
# Solutions Targets:	1		
Failure Criteria:	<input type="checkbox"/> Max Strain		
Load Conditions:	<input type="checkbox"/> All		
# Strength Solutions:	5		
<div> <div>Compute</div> <div>View</div> <div>Apply</div> </div>			

Views			
Top	Side1	IML	
Bottom	Side2	OML	
Front	ISO-1		
Back	ISO-2		
Zoom		1.250	
Move Camera			

[illegible]



**FIG. 34**

$$\begin{aligned} & \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \\ & \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \left\{ \begin{array}{c} \text{[Complex expression with } \gamma, \beta, \alpha, \text{ and } \delta \text{]} \end{array} \right\} \end{aligned}$$

FIG. 36

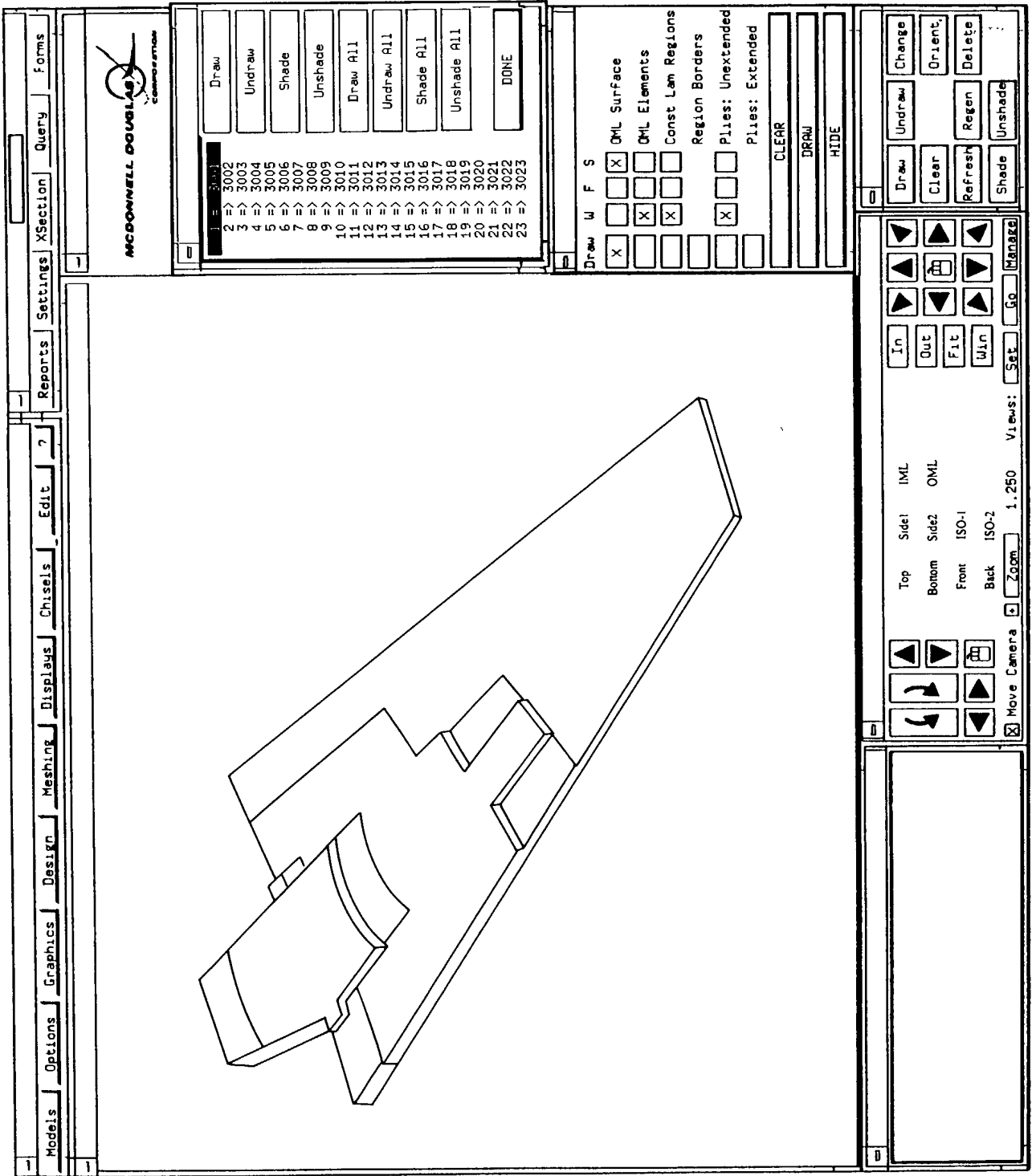


FIG.37

